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TABLE OF CONTENTS

The Turtles and Crocodiles of Thailand and Adjacent Waters With a Synoptic Herpetological Bibliography[1]

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ABSTRACT

The entire known turtle and crocodile faunas of Thailand and adjacent waters are treated, based on collections in Chulalongkorn University in Bangkok and in part on specimens in the EHT-HMS collection in Lawrence, Kansas. The number of species and subspecies here reported is 23 turtles and 3 crocodiles. Certain other specimens of turtles in the Bangkok Zoological Gardens purporting to be from Thailand have been examined. Some of these may also have a place in the Thai fauna, but their provenance is uncertain, some certainly not from Thailand.

INTRODUCTION

This is the fourth of a series of publications on the herpetological fauna of Thailand. The three others deal with the Amphibia (Taylor, 1962b), Sauria (lizards) (Taylor, 1963b), and Serpentes (Taylor, 1965a). This work treats of the Thai Testudines and Crocodylia, together with a synoptic bibliography for the series.

The collections on which these works were based were made chiefly during my sojourns in Thailand, 1958-59, 1961-62, while holding Fulbright Fellowships. These were made available through the kind help of Dr. Supachai Vanijuvadhana, then Secretary General of Chulalongkorn University of Bangkok, Thailand, who was himself greatly interested in the Thai faunas. I was in residence a total of more than 26 months, and of this time more than half was spent in exploration in various parts of the Kingdom. A third journey of about two months duration was made in 1964. This time was spent in the field.

For the most part the synonymies and literature lists refer to articles dealing with Thai specimens or specimens from localities in closely adjoining territory. Where available, Thai specimens were used for the descriptions. Unless otherwise designated, the numbers are those of specimens (at least formerly) in the collections of Chulalongkorn University.

I have included a map of Thailand showing the Changwats (provinces). The numbers have no significance—merely referring to the names.

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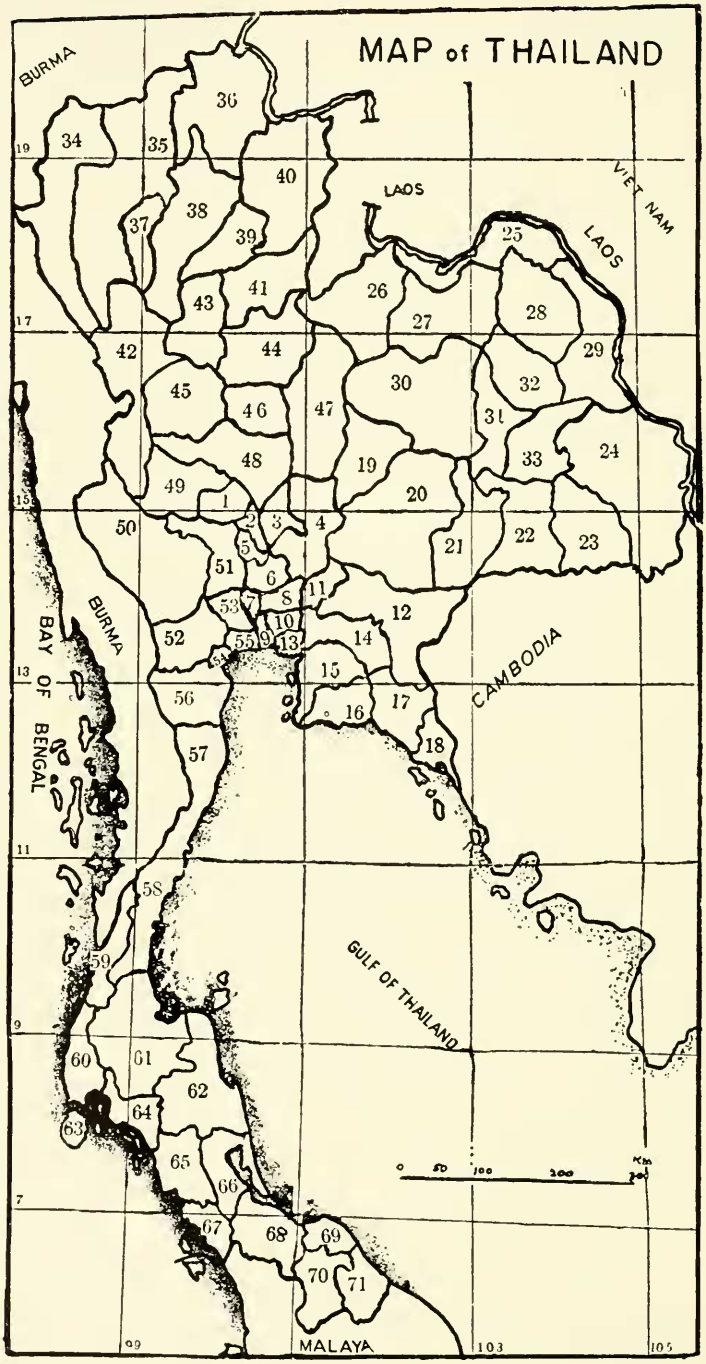

MAP 1. Provinces (Changwats) of Thailand. The numbers refer to the adjoining list of provincial names, and have no significance in themselves.

ACKNOWLEDGMENTS

M. L. Pootipong Nupartpat Varavudhi, an instructor in Chulalongkorn University, accompanied me on many of my earlier journeys of exploration and proved an excellent companion and collector as well as interpreter. I have received much help from Mr. Oliver Gordon Young and his father, Mr. Harold Young, of Chiang Mai, Thailand, both for specimens and for much needed transportation. I am also under very considerable obligation to Dr. Boonsong Lekagul, Secretary General of the Association for Conservation of Wildlife, for his help in collecting, for specimens and for his companionship on numerous collecting trips.

The names of many other persons, whose help has been acknowledged elsewhere in the series, might well have been repeated here.

List of Thai Changwats (Provinces)

Spellings as used by the U.S. Army Gazetteer, 1944.

1. Chainat
2. Sing Buri
3. Lop Buri
4. Sara Buri
5. Ang Thong
6. Ayutthaya
7. Nonthaburi
8. Pathum Thani
9. Thon Buri
10. Phra Nakhon (Bangkok)
11. Nakhon Nayok
12. Prachin Buri
13. Samut Prakan
14. Chachoengsao
15. Chon Buri
16. Rayong
17. Chanthaburi
18. Trat
19. Chaiyaphum
20. Nakhon Ratchasima (Khorat)
21. Buriram
22. Surin
23. Khu Khan (Sisaket)
24. Ubon
25. Nong Khai
26. Loei
27. Udon Thani
28. Sakon Nakhon
29. Nakhon Phanom
30. Khon Kaen
31. Maha Sarakham
32. Kalasin
33. Roi Et
34. Mae Hong Son
35. Chiang Mai
36. Chiang Rai
37. Lamphun
38. Lampang
39. Phrae
40. Nan
41. Uttaradit
42. Tak
43. Sukhothai
44. Phitsanulok
45. Kamphaeng Phet
46. Phichit
47. Phetchabun
48. Nakhon Sawan
49. Uthai Thani
50. Kanchanaburi
51. Suphan Buri
52. Rat Buri
53. Nakhon Pathom
54. Samut Songkhram
55. Samut Sakhon
56. Phet Buri
57. Prachuap Khiri Khan
58. Chumphon
59. Ranong
60. Phangnga
61. Surat Thani
62. Nakhon Si Thammarat
63. Phuket
64. Krabi
65. Trang
66. Phatthalung
67. Satun
68. Songkhla
69. Pattani
70. Yala
71. Narathiwat

TESTUDINES

General Consideration of the Testudines

A considerable number of the herpetologists of the 19th century contributed to the understanding and description of the species, genera, families, and higher groups of the turtles. Cope proposed a suborder Athecae for the huge sea turtle (Leathery Turtle) thus separating the one family, genus, and species (two subspecies) from all other turtles. This has been rather generally accepted by herpetologists. However, Mertens and Wermuth, 1955, in a critical list of the recent turtles, do not recognize the suborder Athecae but place its family Dermochelydidae with the family Cheloniidae under a Sectio Chelonioidea (superfamily?), a treatment which may be questioned.

Boulenger's "Catalogue of the chelonians, rhynchocephalians, and crocodiles" published in 1889 served largely as a guide to turtle classification. In 1909 Siebenrock published his "Synopsis der rezenten Schildkröten mit Berücksichtigung der in historischer Zeit ausgestorben en Arten." This tended to replace as a guide the earlier listing of Boulenger. Williams (1952) offered a tentative arrangement of the Testudinata of the world. The more recent work is that of Mertens and Wermuth (1955), "Die rezenten Schildröten, Krokodile und Brückenechsen: eine kritische Liste der heute lebenden Arten und Rassen."

J. E. Gray, who was largely responsible for the description of genera and species of Asiatic turtles, was able to recognize a number of genera which Boulenger disregarded or rejected. Certain of these were resurrected by Siebenrock (1909). Malcolm A. Smith (1931a), who treated the Eastern Asiatic turtles, also revived certain of Gray's genera. Still others have been resurrected by later authors.

The living turtles now in the zoos in Chiang Mai and Bangkok have for the most part come from various localities in Thailand. However, I am informed that a few have certainly come from neighboring states, and their presence in captivity does not necessarily place them as members of the Thai fauna. I am quite certain, however, that some forms reported in the neighboring parts of Malaya, Burma and in the Indo-China area do occur and and will be added to the Thai list of endemic forms sooner or later.

There is a temple in Bangkok where Thais bring turtles and free them, thus "saving their lives" and by this, gaining merit for a Buddhistic future. I am unaware of the subsequent care of the animals. There are also shops where turtles may be purchased for food in Bangkok and other Thai cities. Thus there is always much traffic in turtles and this offers opportunity for introduction of alien species.

The Testudinate Fauna of Thailand

The species of turtles or tortoises of Thailand are far less numerous than those of the other three herpetological groups (Amphibia, Serpentes, Sauria). The greater number of the species are aquatic (marine or fresh water). Certain ones, however, are completely terrestrial while certain others may be found at least temporarily away from their water habitat. Unlike fishes, most turtles must leave the water or lift the head above water in order to breathe, since they are typically air breathers. Many species occasionally emerge from the water and take a perch on a rock, or log, or they may be seen swimming with their heads above the water surface. Some species are reputed to be capable of limited anal respiration when submerged.

The marine forms are accustomed to return to land to deposit their eggs in pits dug by the female along sandy shores. This pit, one or two feet deep, is prepared by the female shortly after her arrival and then a series of eggs is laid, often as many as 100 or more. These, which may be in several layers, are then covered by pulling in sand to fill the pit above the eggs. Then the female, to conceal the pit location, disturbs the sand for some distance in the neighborhood of the pit so its exact locality is not obvious. The females may lay several times during a season; some species reputedly laying as many as 400 or 500 eggs in a year.

When the young hatch they instinctively burrow to the surface and then move directly toward the water, which they enter, fully equipped for swimming, and breathing, and food finding!

In Thailand it is customary for the government to lease certain areas along the coasts to egg-collectors. The eggs are sought out and dug up to be used as food. They may be consumed locally or they may be marketed at a considerable distance. Seemingly there is always a market for all eggs gathered.

The government also collects a certain number of eggs which are hatched in incubators or sorts, and after a time these young are set free in coastal waters. This presumably is to assure a future breeding population if the egg collectors have been too assiduous. I have observed a release of this type made at the naval station at Sataheep, Thailand.

Locomotion. No known species of turtle has lost its arms or legs. However, the species that entered the ocean have modified the limbs into paddles which externally show little of the original form of these appendages. Occasionally the tip of a digit bearing a claw may be seen, but concealed within the paddle the original large limb bones may be nearly complete, together with at least many of the digital elements.

Oviposition. Malcolm Smith (1931a, pp. 61-62) gives an excellent description of the egg-laying of the Leathery Turtle and subsequent happenings. I quote: "The hole is dug fifteen or twenty meters away from the water's edge

and is much deeper than that made by other Marine Turtles. Like the Green Turtle, the Luth, while digging her nest and depositing the eggs, is completely indifferent to the presence of spectators or noises of any kind. After covering up the eggs, the sand is ploughed up all around for a considerable distance so that, unless the spot has been noted at the time, it is almost impossible afterwards to locate the exact position. May and June are the chief months for oviposition, but eggs are found all the year round. Between 90 and 150 are deposited at a time and several batches are laid during the year. Normally the eggs vary from 50 to 54 mm in diameter but ten or fifteen eggs in each nest are abnormal, being either very small and round or dumbbell-shaped, or of the usual size, but ellipsoid. These eggs are infertile. The period of incubation is 65-70 days. The young as soon as they are born can swim fast and dive easily."

TAXONOMIC TREATMENT

Order TESTUDINES

TESTUDINES Batsch, Versuch einer Anleitung zur Kenntnis und Geschichte der Thiere und Mineralien, vol. 1, 1788, p. 437.

TESTUDINATA Oppel, Die Ordnungen, Familien und Gattungen der Reptiles. . . . München, 1811, p. 3.

"A group of animals with the major part of their skeletons on the outside of their bodies."

Body above with a bony carapace, and below with a bony plastron covered with scutes or scales or, in certain forms, by a leathery covering external to the bones. Ribs attached between two vertebrae have only a single head. Bony dermal materials usually close areas between ribs and likewise cover the vertebrae. Girdles supporting limbs are internal to the ribs. Scapula and coracoid separate; clavicles and interclavicle fused to plastral elements; no sternum present; pelvic girdle free, not incorporated in plastral elements.

Teeth never present; jaw edges covered with a heavy keratin sheath. Limbs pentadactyl, digits free, webbed, or incorporated in paddlelike structures. Male copulatory organ single.

The ancient history of this strange group of animals—strange despite the fact that they are known to most people—is practically unknown, owing to the fact that this chapter of earth history has so far been carefully concealed from the searching eyes of the paleontologist. In the Triassic fossil turtles of various sorts are found that do not differ too greatly from those now living. One may postulate that they existed in the preceding Permian and not impossibly in still earlier periods. However, no adequate proof has been presented of their evolution from other specific reptilian groups that preceded them.

The habits of these animals are very diverse. A few are fitted for a terrestrial existence, but the bulk of the genera and species have been driven

to an aquatic existence presumably because they were better equipped to compete with aquatic animals for food than with their terrestrial competitors.

The purely terrestrial genera are few: *Testudo, Gopherus, etc.* For the most part these manage to exist in areas either isolated from large populations of man or in areas undesirable to competitors. They are, perhaps for the most part, vegetarians, or omnivorous, and are able to maintain their populations by the production of large numbers of eggs, by their ability to withstand hunger for considerable periods of time, and in having a very long life-expectancy.

Despite the diversity of habitat, oviparity is the only method of reproduction, and it is necessary for these aquatic animals to revert to the land for finding suitable places to deposit their eggs. Marine forms utilize the sea beaches, preferably in sandy areas, while fresh water species lay eggs in river banks or shoals. Some river forms even go to higher areas near rivers, or land high enough to escape overflow, and even to the top of nearby hills.

Sea turtles seemingly find it easy to excavate pits to deposit their eggs but turtles that must dig in hardened earth find it necessary to moisten hard dry earth with their urine to soften the surface and if this does not suffice they may return to the water source to fill up their accessory bladders with water and carry this again to the egg-laying area in order to help complete the excavation.

Many turtles have rather an elaborate courtship pattern. One general pattern may obtain in several genera, or perhaps even throughout an entire family. In some species this pattern of behavior may be repeated for several days before actual copulation occurs.

Turtles are a source of human food and both turtles and their eggs are preyed upon by man. In areas where they were once numerous a species may become completely extinct by the advent of man in numbers.

Suborder Athecae Cope

ATHECAE Cope, Amer. Assoc. Adv. Sci., vol. 19, 1870, p. 235; Boulenger, Catalogue of the chelonians, rhynchocephalians and crocodiles in the British Mus., 1889, p. 7; Fauna of British India. . . 1890, p. 50; Hay, Proc. U.S. Nat. Mus., vol. 73, (3), 1928, p. 6.
CHELONOIIDEA (part.) Siebenrock, Zool. Jahrb., Jena, Suppl. 10, 1909, p. 544.
CHELONIOIDEA Mertens and Wermuth, Zool. Jahrb. (Syst.), Band 83, Heft 5, 1955, p. 386 ("Sectio").

Only a single family recognized.

Family **Dermochelydidae** Siebenrock

Sphargidae Gray, Ann. Philos., vol. 10, 1825, p. 212.
Dermochelyidae Siebenrock, Zool. Jahrb., Jena, Suppl., Band, 10, 1909, p. 551.

The family has only a single genus, *Dermochelys*. It occurs in the Atlantic, Pacific, and Indian Oceans, and in the Mediterranean Sea.

Genus **Dermochelys** Blainville

Dermochelys Blainville, Bull. Soc. Phil., 1816, p. 119. (Type of genus, *Testudo coriacea.*)
Sphargis Merrem, Syst. Amphib., 1820, p. 19.
Coriuda Fleming (type, *coriacea*), Phil. Zool., 2, 1822, p. 271.
Seytina Wagler (type, *coriacea*), Isis von Oken, 1828, p. 861. (Substitute name for *Sphargis.*)
Dermatochelys Wagler, Natürliches System der Amphibien mit vorangehender Classification der Saügethiere und Vögel, 1830, p. 133 (type, *coriacea*).
Chelyra Rafinesque (type, *coriacea*), Atlantic Jour., vol. 1, 1832, p. 64.

Diagnosis: Large sea turtles, the young covered with small polygonal shields, largest ones on the soft leathery carapace and plastron. Adult with smooth skin. Young with 7 dorsal keels on carapace and 5 on plastron, the keels covered by raised quadrangular scutes. More or less symmetrical plates or scutes on head, the occipital usually the largest. Tail very short. Arms large flattened paddles; legs, shorter flattened paddles. Only a single living species known.

Dermochelys coriacea (Linnaeus)

Testudo coriacea Linnaeus, Systema Naturae, ed. 12, 1766, p. 350 (type-locality [restricted], Palermo, Sicily).
Dermatochelys coriacea, Günther, Reptiles of British India, 1864, p. 55.
Dermochelys coriacea, Boulenger, Catalogue of the chelonians, rhynchocephalians, and crocodiles in the British Museum (Natural History), 1889, p. 10; Fauna of British India . . . Reptilia and Batrachia, 1890, p. 50; Siebenrock, Zool. Jahrb., Jena, Suppl., vol. 10, 1909, p. 553; Deraniyagala, Proc. Zool. Soc. London, 1930, pt. 3, pp. 1057-1070; Ceylon Jour. Sci., Sec. B, vol. 16, 1930, p. 45; Ceylon Jour. Sci. Colombo Museum Nat. Hist. Ser., vol. 1, 1939, pp. 38-102, figs. 12-34; M. Smith, The Fauna of British India including Ceylon and Burma, Reptilia and Amphibia, vol I, Loricata, Testudines, 1931, pp. 59-62, figs. 6-8.
Sphargis coriacea, Tickell, Jour. Asiat. Soc. Bengal, vol. 31, 1863, p. 367-370. 1 colored plate.
Dermochelys schlegeli, Stejneger, Bull. U.S. Nat. Mus., No. 58, 1907, p. 485.
Dermochelys coriacea schlegeli, Garman, Bull. U.S. Nat. Mus., 1884, No. 25, p. 303 (type-locality, Guaymas, Sonora, México); Carr, Handbook of the turtles of the United States and Canada, 1952, p. 452; Mertens and Wermuth, Zool. Jahrb., Syst., Band 83, Heft 5, 1955, p. 387; Lekagul, Conserv. News, Bangkok, No. 7, 1965 (1966), p. 19, fig.

Diagnosis: Characters of the family and genus.

Atlantic forms differ from those in the Pacific and Indian Oceans so that two subspecies are recognized, only one of which occurs in Thailand waters.

Dermochelys coriacea schlegeli (Garman)

Sphargis coriacea var. *schlegeli* Garman, Bull. U.S. Nat. Mus., No. 25, 1884, p. 303 (type-locality [restricted], Guaymas, Sonora, México). (The type is figured in Temminck and Schlegel.)
Sphargis angusta Philippi, An. Univ. Santiago de Chili, vol. 104, 1899, p. 728 (type-locality, Tocopila, Chile).
Dermochelys coriacea schlegeli, Carr, Handbook of the Turtles of the United States and Canada, 1952, p. 452; Mertens and Wermuth, Zool. Jahrb. (Syst.), Band 83, Heft 5, 1955, p. 387.
Dermochelys coriacea M. Smith, The fauna of British India including Ceylon and Burma, Reptilia and Amphibia, vol. 1, Loricata, Testudines, 1931, pp. 59-62 *(part.).*

The status of *schlegeli* as a subspecies is based largely on the fact that the average known size of the Pacific form of *coriacea* is larger than that in the

Atlantic. There are other small differences recorded but it is not certain that these are constant. No one has been able to make a direct comparison of a series of these huge animals. Carr *(loc. cit.)* reports specimens with a body two meters in length—in fact, one reported from Australia reached nine feet in length. Other specimens are reported as weighing from 800 to 1600 lbs.

Compared with the typical form the head is said to be proportionally longer, the scales of the head less symmetrical, and the arms shorter in proportion to length.

Description: In young animals, body and limbs covered with small, irregular, usually polygonal shields. These larger on carapace and plastron than on other parts. Seven keels on dorsal part of carapace, made of larger raised quadrangular shields; five keels on plastron, the median often presenting a double row. These keels may converge and meet anteriorly and the three median meet posteriorly. Scutes on remainder of surfaces smaller, nearly uniform except for a few larger series on edges of limbs.

These shields or scales tend to disappear completely in older animals, but traces of the keels remain visible on carapace as nodular ridges. Keels on plastron tend to disappear completely. Arm bones encased in long fleshy paddles which, in the young, approach length of carapace, but become proportionally shorter in adult.

Color: The adult is colored—"Dorsally a slaty black with three or four longitudinal rows of small white spots not larger than the iris extending between each pair of carapace ridges. These spots are more numerous at the base of the flippers. Head black with a few white blotches. Jaws white, clouded with black. Neck with five longitudinal rows of white spots. Ventrally pinkish white or white, usually with dark reticulation representing scale marks. A black lateral band usually extends from the inguinal area to the cloaca. Sometimes in females the black disappears more or less from the plastron. The top of the caudal crest is white. Newly hatched young are an intense blue black marked with white to whitish; the encroaching black imparts a bluish appearance." Deraniyagala (1930a).

The markings on the adults are similar to those of the young but probably less well defined.

Measurements: Total length, 7 ft. 5 in.; length of carapace, 5 ft. 3 in.; carapace width, 2 ft. 10.5 in.; width of flipper to flipper, 4 ft. 3 in. (From Carr, 1952.)

Remarks: One Thai specimen is figured by Dr. Boonsong Lekagul (1966).

Superfamily **Cryptodira**

Shell with plastron and carapace fused laterally and covered with epidermal horny plates or scales. Head can be withdrawn within shell, the neck

forming a sigmoid bend in a vertical plane. Pelvic girdle not fused to carapace or plastron; pterygoid bones form a median suture for greater part of their length, usually narrowed in their middle. Area above tympanic cavity notched, not roofed over; squamosals and parietals widely separated; fingers and toes distinct, usually with three or less phalanges; four or five claws present. A set of marginals connecting with ribs.

The greater number of Asiatic turtles are associated in this superfamily which includes the families *Platysternidae, Emydidae,* and *Testudinidae.*

Family **Platysternidae** Gray

Platysternidae Gray, Supplement to the catalogue of shield reptiles in the collection of the British Museum, pt. 1, Testudinata (tortoises), 1870, p. 69.

This family was based on a single genus and species—*Platysternon megacephalum* Gray, confined to southeast Asia. This arrangement has been accepted by almost all subsequent students of the Testudines.

Head large, the neck retractile within shell; jugal completely surrounded by bones not forming part of orbital border; temporal region completely roofed over with bones; phalanges with condyles; five claws on hand, four on foot; nuchal bone lacking a riblike process; plastron separated from carapace by several intercalated inframarginals. Tail greatly elongated, covered above and below with heavy scutes, the median dorsal ones keeled; at base of tail and on thighs numerous enlarged conical scales.

Genus **Platysternon** Gray

Platysternon Gray, Proc. Zool. Soc. London, 1831, p. 106 (type of genus, *megacephalum*).

Diagnosis: Plastron much smaller than opening of carapace, connected with carapace by ligamentous tissue. Head large, with powerful jaws covered with a horny shield, the back part of which shows what appear to be lines of growth; upper jaw strongly hooked, extending beyond mouth; five fingers with claws; four toes with claws, the webbing not quite reaching base of claws; scutes on tail quadrangular, arranged in transverse as well as longitudinal lines; axillary and inguinal scent-glands.

Some Thailand specimens of this turtle seem to vary considerably. Thus a young specimen figured and described by Taylor and Elbel (1958) shows considerable difference in shape from the adult type of carapace. There are five costals, the vertebrals being considerably wider than the costals. The lateroposterior marginals are larger than the three posterior costals. The posterior margin of shell is serrated.

This specimen, which had lost its tag, was said to be "practically certain that it came from Dan Sai district in the province of Loei." Certain other older specimens from Phu Kading mountain, 5000 ft., Loei Province, do not show these characteristics.

Platysternon megacephalum Gray

Platysternon megacephalum Gray, Proc. Zool. Soc. London, 1831, pp. 106-107; Illustration of Indian Zoology, vol. 2, 1834, p. 62 (type-locality, "South Chine"); Stejneger, Proc. U.S. Nat. Mus., vol. 66, 1925, p. 102; Schmidt, Bull. Amer. Mus. Nat. Hist., vol. 54, 1927, p. 400-401, fig 1.

Platysternum megacephalum Theobald, Jour. Linnaean Soc., Zool., vol. 10, no. 41, 1868, pp. 17-18; Boulenger, Catalogue of the chelonians, rhynchocephalians and crocodiles in the British Museum, 1889, p. 46 *(part.)*; Ann. Mag. Nat. Hist., ser. 5, vol. 19, 1887, p. 461, pls. 16, 17; The Fauna of British India including Ceylon and Burma, Reptilia and Batrachia, 1890, p. 44, figs. 13, 14; Siebenrock, Zool. Jahrb., Jena, Suppl. 10, 1909, p. 450; Mell, Arch. Naturg., vol. 7, 1922, pp. 390-475; *ibid.*, Heft 10, 1922, p. 108; M. Smith, Jour. Nat. Hist. Soc. Siam, vol. 1, pt. 3, 1915, p. 155 (Sai Yoke) *(part.)*; *ibid.*, vol. 2, no. 1, 1916, p. 51 ("Western and ? Northern Siam"); The Fauna of British India, including Ceylon and Burma, Reptilia and Amphibia, vol. 1, Loricata, Testudines, 1931, pp. 74-75, fig. 13 (skull) *(part.)*; Pope, The Reptiles of China, Nat. Hist. Cent. Asia, vol. 10, 1935, 1-604; Wermuth, Aquar.—Terrk., Leipzig, Band 5, pp. 161-165; *part.*; Taylor and Elbel, Univ. Kansas Sci. Bull., vol. 38, pt. 2, Mar. 20, 1958, pp. 1079-1081, fig. 15.

Two subspecies, *Platysternon megacephalum megacephalum* and *P. m. peguense* are recognized. The first is known only in southern China.

Platysternon megacephalum peguense Gray

(Fig. 1)

Platysternon peguense Gray, Supplement to the catalogue of the shield reptiles in the collection of the British Museum, part 1, 1870, p. 70 (Type-locality, Pegu, Tenasserim, Burma).

Platysternon megacephalum peguense, Wermuth, Zoologische Beiträge Neue Folge, Band 5, Heft 2/3, 1960, pp. 481-482.

Platysternon megacephalum, Mertens and Wermuth, Zool. Jahrb., Syst., Jena, 1955, Band 83, p. 341, *(part.)*; Taylor and Elbel, Univ. Kansas Sci. Bull., vol. 38, pt. 2, Mar. 20, 1958, pp. 1079-1081, fig. 15.

Platysternum megacephalum, Legakul, Conservation News, Bangkok, No. 7, 1966, pp. 56-57, figs.

Diagnosis: Characters of family and genus. Plastron of young and half-grown with a clearly defined longitudinal symmetrical dark marking completely or partially split by a light median line, and with lateral dark projections on each side. A median dorsal keel, dark colored, with one or two lighter spots, and a series of three small black bosses on the two costal series. Markings less conspicuous or absent in old specimens.

Description of subspecies (from No. 1650 Loei Province, Thailand): Carapace much depressed, length much greater, than width, with a median keel present, evident on first and last three shields; costals with slightly elevated points at middle of areolae; nuchal single, 2.5 times wider than long; first vertebral strongly convex anteriorly, much wider than long, notched posteriorly. Measurements in mm of vertebrals and costals, length x width: first vertebral, 28 x 44; second, 31.5 x 43; third, 29 x 44; fourth, 30 x 41; fifth, 39.5 x 37. First costal, 34 x 32; second, 37 x 47; third, 33 x 42; fourth, 34 x 30. On each side 12 marginal scales other than nuchal; supracaudals scarcely notched at their mutual suture, both tectiform; a slight posterior

projection from fifth vertebral wedged between front part of their mutual suture, and a slight emargination on posterior edge of each; some posterior marginals slightly recurved.

Plastron much narrower than opening of carapace; anterior plastral lobe nearly square; front of carapace truncate, posterior end broadly angulate; abdominal shields somewhat concave. A short bridge, its length (30 mm) much longer than posterior lobe. Measurements in mm of median sutures of plastral shields: gulars, 7; humerals, 20; pectorals, 25; abdominals, 12; femoral, 25; anal, 26. A small median azygos scale between gulars and humerals, its length 9 mm; its width, 9.5 mm. Tail longer than carapace; base of tail and dorsal area on back of thighs with numerous large conical scales, some reaching a height of 9.5 mm; about 28 paired quadrangular subcaudals (the 2 or 3 terminal ones may be single) covering ventral surface, and bending up on sides of tail; a median dorsal row of scales, more or less keeled; a lateral row on each side extending to near tip of tail, with occasional ones fused to adjoining scute; a short intercalated row of 4 scales near base; a series of small irregular scutes between plastron and carapace but no distinctive axillary or inguinal scutes present.

Front of arm with large irregular scutes, somewhat wider than long; scutes on posterior face of arm, larger and fewer; leg and thigh with numerous small scutes, those on under posterior face, largest.

Color: Nearly uniform light brown; head same color; underside of marginals and plastron uniform yellowish or yellow-brown.

Measurements in mm of Nos. 1650 and 1651 respectively: Length of carapace, 167, 167; width of carapace, 132, 128; depth of carapace, 51, 53; length of plastron, 132, 136; width of plastron at bridge, 98.5, 99; width of anterior lobe, 63, 68; width of posterior lobe, 71, 74; length of posterior lobe, 56, 62; tail, 198, (broken); width of head, 52, 54.

Variation: An azygos median scale occurs on the plastron of certain specimens from northern Thailand. Another specimen of unknown provenance shows no trace of the azygos scale but the measurements closely approximate those of the described specimen; the nuchal is abnormally divided. This specimen, despite having almost the same measurements, has the carapace glassy smooth with no suggestion left of the sculpturing produced by lines of growth which are strongly pronounced in the described specimen. The latter is anomalous in having a small intercalated scale between the fourth costal and the fifth vertebral (see comment on a young specimen under "Remarks").

Distribution: In Thailand the species has been taken in the provinces of Loei (Dan Sai and Phu Kading), Kanchanaburi (Sai Yoke), and Chiang Mai.

Remarks: Mr. Harold Young, who has the zoo in Chiang Mai, tells me

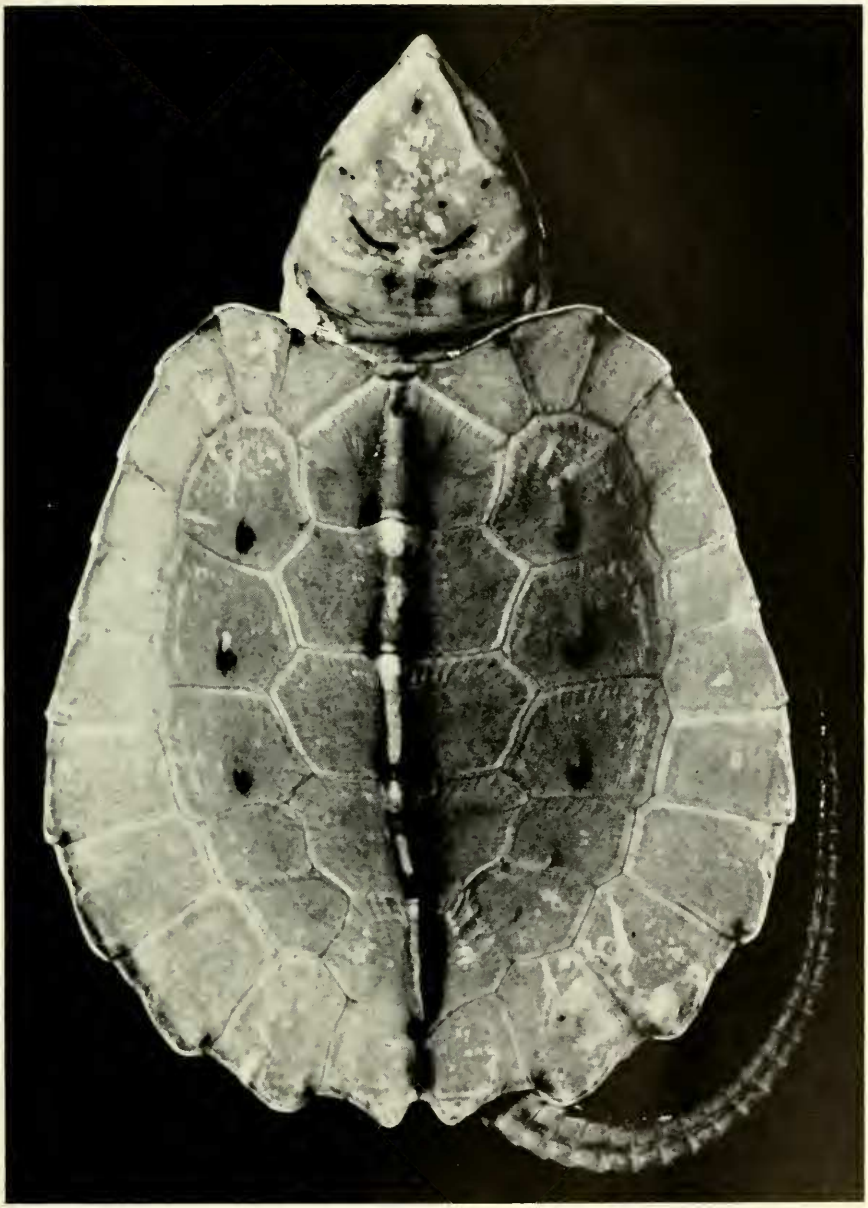

FIGURE 1. *Platysternon megacephalum peguense* Gray. Kansas U. Mus. Nat. Hist. No. 40084. Lomlo Mt., Thailand. Carapace length, 50 mm; carapace width, 44 mm; tail length, 52 mm.

that this species is very adept at climbing and that the specimens often escape by climbing from the high wire enclosures where they are kept.

The species is usually taken at a considerable elevation along mountain streams. They are reputed to be able to climb trees and shrubs along the streams.

Theobald (1868) reports a specimen from Martaban, Burma. The specimen is very young (shell, 2 in.; tail, 2.25 in.); "color fleshy gray, each of the costal shields with a central black tubercle; beneath bright reddish-orange with a little black above the sutures. Head dark-mottled, with a black-edged yellow stripe behind the eye. Iris pale yellow."

"This species is rare in Pegu, and seems confined to the streams in the hills east of Tonghu, falling into the Sittang and Salwin."

Family **Emydidae** Gray

Emydidae Gray, Annals of Philos., 1825, (2) vol. 10, p. 210.

Head capable of being withdrawn wholly within the shell. Head covered with smooth skin; posterior part of latter usually divided into small scale-like sections. Temporal region not roofed over. Nuchal plate lacking a riblike process; nine bones in the plastron. A bony temporal arch present or absent (may become lost during lifetime of an individual). Median digits with three phalanges; metacarpals elongate; 4 or 5 claws present. Bones of carapace and plastron covered with horny epidermal shields or scutes, those on plastron directly in contact with marginals.

The family has a cosmopolitan range with some 20 genera, 9 of which are represented in Thailand. These are *Cyclemys, Pyxidea, Cuora, Heosemys, Malayemys, Hieremys, Notochelys, Siebenrockiella* and *Batagur.*

Recently McDowell (1964) has proposed two subfamilies; Batagurinae and Emydinae, the former confined to Asia, largely including all the genera listed for Thailand.

Subfamily **Batagurinae**

Batagurinae McDowell, Proc Zool. Soc. London, vol. 143, pt. 2, 1964, pp. 239-279.

Genus **Cyclemys** Bell

Cyclemys Bell, Proc. Zool. Soc. London, 1834, p. 17 (type of genus *C. orbiculata*); Mertens and Wermuth, Zool. Jahrb. Syst., Band 83, Heft 5, 1955 p. 348.

Diagnosis: Shell longer than wide, strongly serrate on posterior border of carapace, less so anteriorly; carapace with 1 or three keels more or less strongly developed. Front lobe of plastron develops a hinge as animal grows older, this between hypoplastral and hyoplastral bones, and only front lobe moves but does not close entirely. Entoplastron intersected by suture. Skull usually with a bony temporal arch. Digits between one-half and completely

webbed. Tail proportionately shorter in adults than in young. Neural plates usually hexagonal in shape, the posterior boundary shortest.

The genus is oriental in its distribution, specimens being known from Burma to Viet Nam, Malaya, Indonesia and Philippines.

Cyclemys dentata (Gray)

(Figs. 2-3)

Emys dhor (part.) Gray, Synopsis Reptilium, pt. 1, 1831, p. 20 (corrected to *dentata* in errata); Illustrations of Indian Zoology, 1830-1835, vol. 2, 1834, pl. 58, fig. 2 (only); (type-locality, Java).

Cyclemys dentata Gray, Catalogue of the shield reptiles in the collection of the British Museum, pt. 1, Testudinata (tortoises), 1855, p. 42, pl. 19; M. Smith, The fauna of British India, including Ceylon and Burma. Reptilia and Amphibia, vol. 1, Loricata, Testudines, Mar. 31, 1931, pp. 80-82, fig. 15; Mertens and Wermuth, Zool. Jahrb., Syst., Band 83, Heft 5, Oct. 31, 1955, p. 348 (synonymy).

Cyclemys dhor, Gray, Supplement to the catalogue of shield reptiles in the collection of the British Museum, pt. 1, Testudinata (tortoises) I, 1870, p. 23; Morice, Coup d'oeil faune Cochinchine, 1875, p. 63; Boulenger, Catalogue of the chelonians, rhynchocephalians, and crocodiles in the British Museum, 1889, p. 131; The fauna of British India, Ceylon and Burma. Reptilia and Batrachia. 1890, p. 30; Siebenrock, Sitzungsb. Akad. Wiss, Wien., vol. 112, Abt. 1, 1903, p. 341; M. Smith and Kloss, Jour. Nat. Hist. Soc. Siam, vol. 1, pt. 4, Dec. 1915, p. 238 (Koh Chang, and "Hup Bon, east of Sriracha"); M. Smith, Jour. Nat. Hist. Soc. Siam, vol. 2, June 1916, p. 51 ("widely distributed in Thailand; common in certain localities"); M. Smith, Bull. Raffles Mus., no. 3, 1930, p. 8.

Cyclemys orbiculata Bell, Proc. Zool. Soc. London, 1834, p. 17; Monograph of the tortoises having a movable sternum. . . . Zool. Jour. London, 1842, pt. 8, pls. 2-3 (type-locality, India); Theobald, Catalogue of reptiles in the museum of the Asiatic Society, 1868, p. 10; Jour. Linnaean Soc., Zoology, vol. 10, no. 41, pp. 12-13.

Cyclemys oldhami Gray, Proc. Zool. Soc., London, 1863, p. 178 (type-locality, Mergui); Günther, The reptiles of British India, 1864, p. 15, pl. 5.

Cyclemys ovala Gray, Proc. Zool. Soc. London, 1863, p. 178 (type-locality, Sarawak).

Cyclemys belli Gray, Proc. Zool. Soc. London, 1863, p. 179 (type-locality, Madras or Bombay).

Cyclemys dhor shanensis Annandale, Rec. Ind. Mus., vol. 14, 1918, p. 67, pl. 20 (type-locality, Inle Lake, Burma).

Diagnosis: A single median keel on carapace, distinct except in aged specimens where only posterior part is indicated; young flattened, adults arched and slightly flattened on dorsum; skin on top of head not divided, except large scute behind eye, which is partly divided, and some small scutes bordering nuchal region; nuchal scute nearly twice as long as wide; longest plastral suture between pectoral scutes; gulars openly emarginate; anal notched; posterior border of carapace serrate.

Description of species (from no. 1641, Bhetong, Yala): Carapace well arched, median dorsal vertebral area somewhat flattened; a distinct median keel, obtuse anteriorly, sharp posteriorly; nuchal (12 x 6.4 mm) much longer than wide; first vertebral scale (28 wide x 25 mm long) wider anteriorly than posteriorly, lateral sutures sinuous; second, third and fourth vertebrals wider than long, wider anteriorly than posteriorly; fifth narrowed anteriorly, widened posteriorly, much wider than long (44 x 25 mm); costals wider than long, first 3 larger than vertebrals, fourth (21 x 24 mm) smaller than

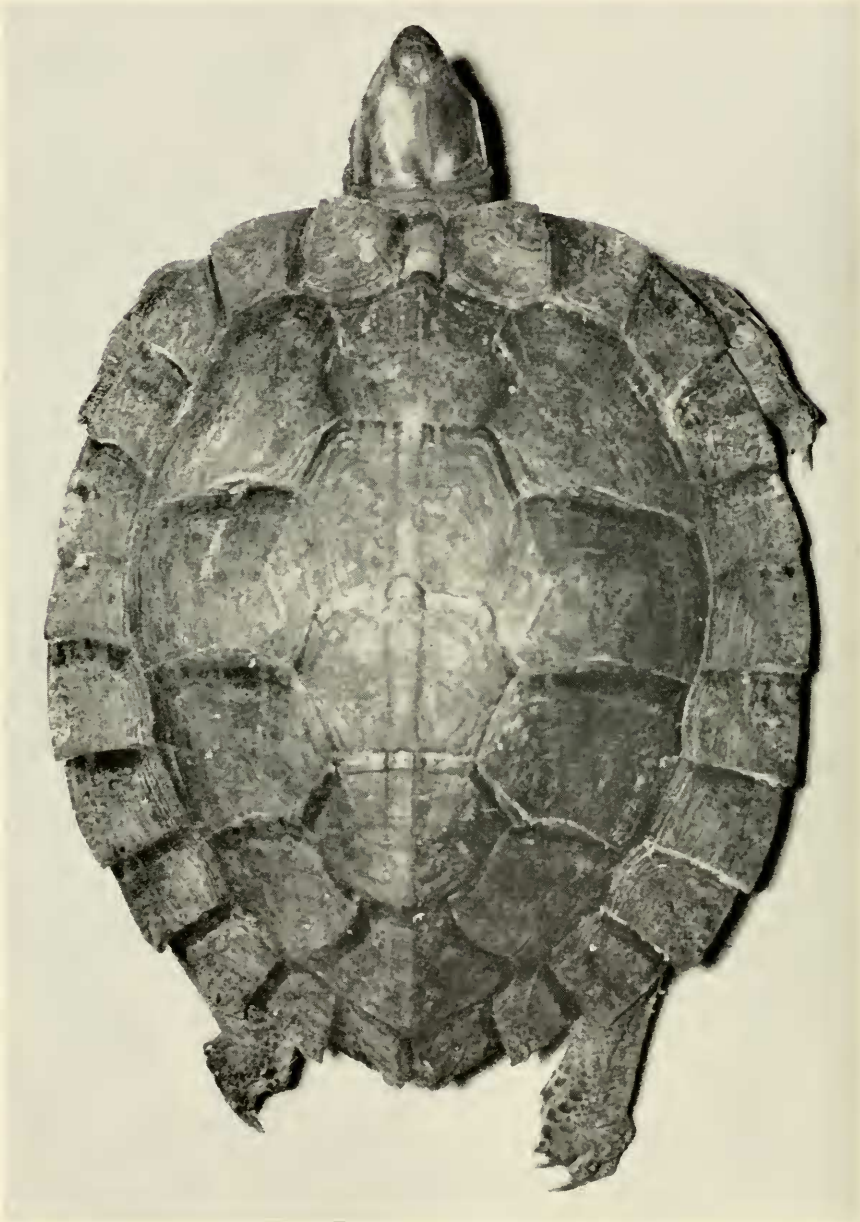

FIGURE 2. *Cyclemys dentata* Gray. Chulalongkorn Univ. No. 1641, Bhetong, Yala, Thailand. Carapace length, 141 mm; carapace width, 124 mm.

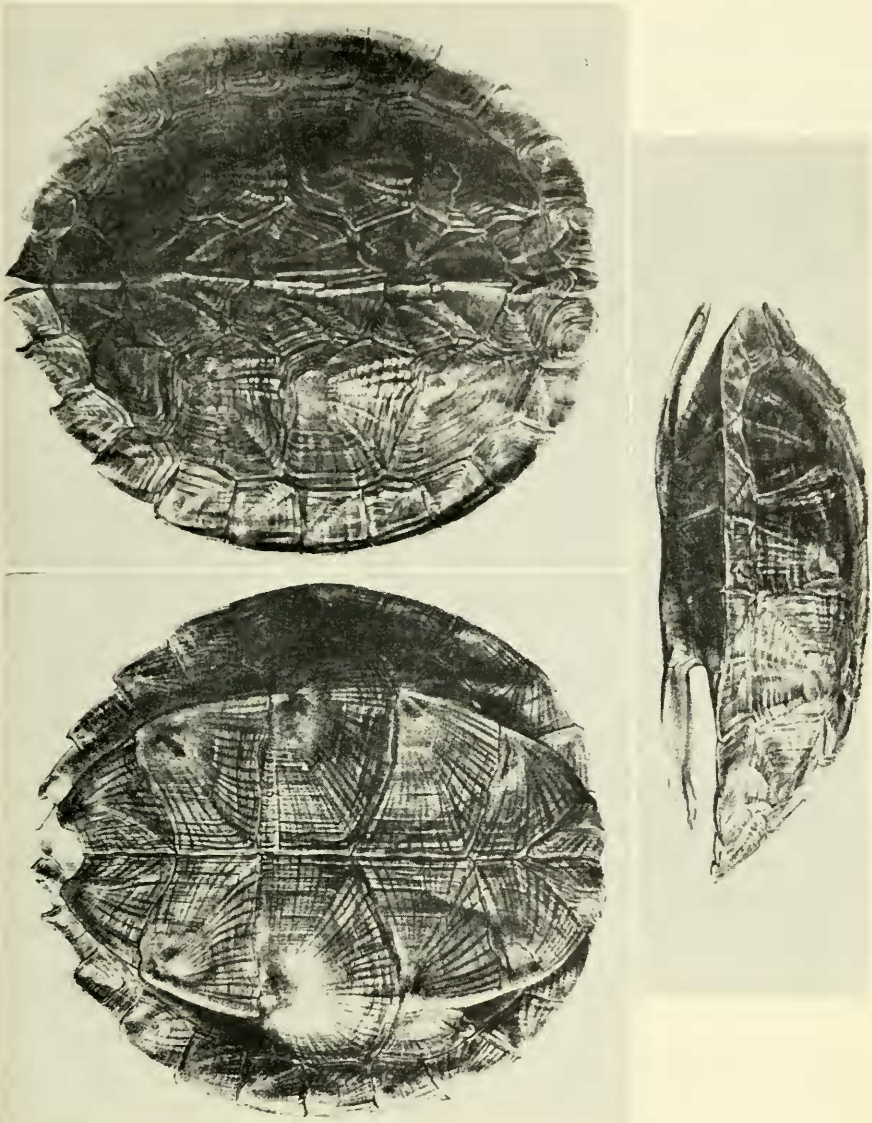

Figure 3. *Cyclemys dentata* Gray. From Gray, Catalogue of the shield Reptiles etc., 1855, pl. xix.

vertebrals; marginal scutes 12 on each side, supracaudal divided, with a distinct notch 3 mm deep; plastron slightly shorter than carapace (12 mm); sutures of plastral scales in following descending order of length: pectorals, abdominals, gulars, anals, femorals, humerals; axillary and inguinal scutes distinct; bridge moderate, approximately 30% of length of plastron.

Head rather small; snout shorter than orbit, projecting but slightly, tip feebly bicuspid; skin on top of head undivided except posterior part; 2 scales lying behind eye; a single scute covering front of upper jaw; lower jaw with a single scute followed posteriorly by an enlarged scute; about 14 rows of small scales precede ear, which is covered with small scales; hands and feet webbed to the claws; front face of arm with about 20 enlarged transverse scales; on posterior face a small patch of 6 or 7 enlarged scales; tail short; foot with about 10 enlarged scales on heel; adjoining them above along edge, another small group of larger scales; tail with paired, somewhat enlarged subcaudals (terminal part of tail missing).

Color: Carapace dark brown to olive-black, nearly uniform, without evidence of black rays; on plastron radiating lines of black and dull yellow, conspicuous from pectorals to anals; gulars and humerals nearly uniform black; head olive-brown above and on sides with black and olive radiating lines on upper and lower jaws; sides of neck yellowish olive with longitudinal black stripes, upper sloping above ear, the next reaching angle of jaws; 7 or 8 stripes separated by dotted lighter lines on throat. Axillary and inguinal regions yellow with a few black dots or marks.

Measurements in mm: Length of carapace, 141; width of carapace, 124; length of plastron, 134; width at posterior end of bridge, 70; width at anterior end of bridge, 58; depth of shell, 55; length of median plastral sutures: gulars, 21; humerals, 14; pectorals, 26.5; abdominals, 23; femorals, 18; anal, 21; width of head, 20; length of head, 24.

Variation: Differences between young and adults are considerable. Malcolm Smith (1931a) states that old specimens may lose the keel entirely, and the serration of the carapace edge is less marked; the vertebrals are broader anteriorly than posteriorly in young and half-grown, while the reverse is true in old specimens. There may be differences in the length of the plastral sutures on the medial line, but usually the pectoral suture is longest. A transverse hinge may develop. The tail is proportionally longer in the young than in the adult. A specimen from Burma is light brown with black spots. The shell may reach a length of 240 mm, 175 mm width, 82 mm depth.

Distribution: In Thailand the species occurs rather widely. Specimens have been taken at the Sanoi River Forestry Station, near the Cambodian border in eastern Ubon; specimens have been reported from "Kampong

Jalor" in Pattani; Hup Bon, and Sriracha in Chon Buri; Ban Kok Klap, in Chumphon. The described specimen is from Bhetong, Yala.

Outside of Thailand the species is known in India, Burma, Cambodia, Malaya, and the Indo-Australian Archipelago.

Remarks: The specimen taken on the Cambodian border of eastern Ubon, although a little larger than the described specimen (141 mm carapace length), has fewer lines of growth and the areolae are much more distinct and rugose. The color is light brown above, the plastron blackish brown with the yellowish radiating lines apparent, especially near the sutures. A yellow line present on the lower jaw. The head above is grayish with fine black flecks; darker and lighter longitudinal lines appear on the nuchal region while the lateral stripes on sides of neck are much less distinct.

Theobald (1868) points out that Bell has stated that this species *(orbicularis)* affords a link between the box tortoises and the more typical Emydidae. However, the describer (Bell) failed to notice the pseudo-hinge, the homologue of the ligamentous hinge in *Cuora* although in *orbicularis* the motion of the two portions is limited, owing to its being the result merely of the permanent non-union of the toothed suture of the pectoral and abdominal bony plates, and not of a special ligamentous division. It is imperceptible in the very young animal, but the motion of the plates develops it as the animal grows and in adult or aged ones is often marked externally by a "carious fossa." This character is evident in the type *oldhami* which Theobald himself collected.

The specimen described by me shows at this stage (total length 143 mm [53.8 in.]), no trace of the hinge or any movement. This was the case of Theobald's 5-inch halfgrown specimen but he mentions "Sternal suture distinct." The color of the plastron "Sternum deep brown or blackish; yellow-rayed," is duplicated in my described specimen.

Genus **Pyxidea** Gray

Pyxidea mouhoti Gray

Cyclemys mouhoti Gray, Ann. Mag. Nat. Hist., ser. 3, vol. 10, 1862, p. 157 (type-locality, "Laos Mountains, Annam-Siam Border"; Boulenger, Catalogue of the chelonians, rhynchocephalians, and crocodiles in the British Museum (Natural History), 1889, p. 132; Fauna of British India. . . . 1890, p. 31; M. Smith, The fauna of British India, including Ceylon and Burma. Reptilia and Amphibia, vol. 1, Loricata, Testudines, 1931, pp. 78-80, fig. 14 (shell); Mertens and Wermuth, Zool. Jahrb., Syst., Band 83, Heft 5, 1955, p. 348.

Pyxidea mouhotii, Günther, Reptiles of British India, 1864, p. 16, pl. 4; Jerdon, Proc. Asiat. Soc. Bengal, 1870, p. 68; Siebenrock, Sitzb. Akad. Wiss. Wien, Band 112, Abt. 1, 1903, p. 345, pl. 1, figs. 3, 4; Schmidt, Bull. Amer. Mus. Nat. Hist., vol. 54, 1937, p. 407.

Diagnosis: Carapace serrate especially posteriorly, and strongly tricarinate. Dorsal part flattened along mesial region. Head lacking stripes. Digits half-webbed.

Description of species: Carapace a little longer than wide, slightly serrate anteriorly, distinctly so posteriorly. Twelve pairs of marginals including supracaudals which are smallest of all. Nuchal scale single, small, narrow. Five vertebral shields usually hexagonal, narrower posteriorly than anteriorly (except first), and wider than long (except last). Four costals on each side (rarely more, 6-7) likewise wider than long. Three keels, median best defined, the 2 lateral keels on costals curving. Plastron smaller than ventral opening of carapace, truncate anteriorly, with notch posteriorly. Plastron attached at a short but distinct bridge, its width equal to one third length of plastron, area of attachment chiefly by hypoplastral bone.

Head medium in size, truncate: snout shorter than orbit. Numerous shields of moderate size on posterior part of head. Front of arm with large imbricating horny shields; legs generally club-shaped, their lower parts covered with imbricate scales pointed at their tip; digits about half webbed. Tail of moderate length, the skin at its base and adjoining areas on thighs with pointed tubercles.

Color: Generally uniform light brown above on carapace; yellowish brown on plastron, with dark areas on each shield. Head brown with dark flecks or small spots; light spots on sides of head.

Measurements in mm: Total length of carapace, 160; width, 112; height, 58. (Description from literature.)

Remarks: The exact type-locality is not known. Mouhot collected along the Thai border and is known to have collected in parts of Eastern Thailand.

Genus Cuora Gray

Cuora Gray, Catalogue of the shield reptiles in the collection of the British Museum pt. 1, Testudinata (Tortoises); 1855, p. 41. Type of genus, *C. amboinensis.*

Cyclemys Boulenger, Catalogue of the chelonians, rhynchocephalians, and crocodiles in the British Museum, 1889, p. 128; Fauna of British India, Ceylon and Burma. Reptilia and Batrachia. 1890, p. 28 (part); Mertens und Wermuth, Zool. Jahrb., (Syst.), Band 83, Heft 5, 1955, p. 347.

Diagnosis: Plastron hinged, the anterior and posterior parts movable and capable of completely closing opening of carapace, fore and aft. Plastron joined to carapace by ligamentous tissue, not forming a typical bridge. Entoplastron with suture. Skull usually with bony temporal arch (incomplete in a Chinese species). Alveolar jaw surface narrow; digits completely webbed; tail rather short. Only one of the four species is known to occur in Thailand. This is the widespread type-species, *Cuora amboinensis.*

Cuora amboinensis (Daudin)

Testudo amboinensis Daudin, Histoire naturelle, générale et particulière des reptiles, vol. II, chelonians and crocodilians, 1802, p. 30 (type-locality, Amboyna).

Kinosternon amboinense, Bell, Zool. Jour., vol. 2, 1825, p. 305.

Cistudo amboinensis, Gray, Illustrations of Indian Zoology . . . , 1830, vol. 1, pl. 77; Cantor, Jour. Asiat. Soc. Bengal, vol. 16, 1847, p. 611.

Cuora amboinensis, Gray, Catalogue of the shield reptiles of the British Museum, Testudinata (Tortoises), 1855, pt. 1, p. 41; Günther, The reptiles of British India, 1864, p. 12, p. 4; Gray, Supplement to the catalogue of shield reptiles in the collection of the British Museum, pt. 1, Testudinata, 1870, p. 21, figs.; M. Smith, The fauna of British India including Ceylon and Burma. Reptilia and Amphibia. vol. 1, Loricata, Testudines, 1931, pp. 84-86, plate 1, fig. 4, text fig. 16; Mertens and Wermuth, Zool. Jahrb., Syst., Band 83, Heft 5, 1955, p. 347.

Cyclemys amboinensis, Boulenger, Catalogue of the chelonians, rhynchocephalians, and crocodiles in the British Museum, 1889, p. 33; The fauna of British India, Ceylon and Burma, 1890, p. 31, fig. 10; Siebenrock, Sitzungb. Akad. Wiss. Wien., Band 112, abt. 1, 1903, p. 343; Zool. Jahrb., Suppl. 10, 1909, p. 503; Flower, Proc. Zool. Soc. London, 1899, p. 614; Boulenger, Fasciculi Malayenses, Zool., vol. 1, 1903, p. 142; A vertebrate fauna of the Malay Peninsula. . . . Reptilia and Batrachia, 1912, pp. 21-22.

Emys couro Schweigger, Prodromi monographiae cheloniorum, pt. I, 1814, p. 46 (type-locality, Java).

Terrapene bicolor Bell, Zool. Jour., vol. 2, 1825, p. 484, pl. 16. Type-locality unknown ("type from America" *ex errore*).

Diagnosis: Carapace depressed in young, tricarinate, usually strongly convex, with an obsolescent keel in adult males and females; plastron as large as opening of carapace, lacking a distinct bridge; axillary and inguinal scales absent or very small; distinct hinge between pectorals and abdominals (hyo- and hypoplastral bones) both lobes being movable, and capable of closing shell completely. Plastron rounded posteriorly, with a feeble median nick; digits fully webbed; sole of foot with numerous small flat scales.

Description of species (No. 1642, EHT-HMS Collection.): Carapace somewhat compressed, high, convex; median dorsal region not depressed or flattened; distinct evidence of a median keel; nuchal scute small, narrow, more than twice as long as wide; anterior vertebral scute wider anteriorly (33 mm) than posteriorly (29.5 mm); length of scale, 33 mm; second vertebral as long as wide; third and fourth distinctly wider than long; last longer than wide; first costal as wide as long; second, third, and fourth wider than long; marginals erect, the subcaudals flaring somewhat; marginals not serrate, lacking notch between subcaudals.

Plastron strongly concave (♂), as wide as opening in carapace; no bridge between plastron and marginals; no distinct axillary or inguinal scales; the space between plastron and marginals with small irregular scutes or divided skin; front section of plastron rounded; a hinge between pectoral and abdominal scutes leaving both parts of plastron movable and capable of closing the openings completely; posterior section of plastron rounded, with a tiny median notch; plastron narrowed at suture between abdominals and femorals; length (in mm) of common sutures of plastral scutes: gular, 30; humeral, 7; pectoral, 32.5; abdominal, 38; femoral, 15; anal, 40.

Head moderately large, snout rather pointed. Skin or head undivided on anterior half, posterior half broken into 2 large scales; area in front of lower tympanic area covered with minute scales; upper jaw and lower jaw each covered with a single scute; no enlarged scute posterior to lower jaw; upper

jaw slightly hooked anteriorly; skin over ear partly broken into scutes; front of arm covered with transverse, enlarged, somewhat imbricating scutes, a row of elongate scales along the dorsal surface; 4 large scales on posterior face of arm arranged transversely. Fingers almost completely webbed; heel with a few enlarged scutes above and below with other enlarged scutes above each toe and finger; underside of hand and foot with numerous rather small, flat scales; paired scutes under tail with enlarged irregular scales at tip. Snout a little shorter than orbit.

Color: Above nearly uniform blackish on carapace; top of head brownish, growing black posteriorly; top of neck gradually becoming gray. A dark-edged yellow stripe runs from neck above and meets its fellow on tip of snout; a broad black stripe below this passes through eye, narrowing and terminating at tip of snout; a broad yellow stripe from neck crosses ear, bisected by a black line from in front of ear to tip of snout, bordered below by a narrow black line. Underside of neck and chin dirty yellowish white.

Plastron and underside of marginals pale yellowish, each marginal with a peripheral black spot. Plastron with a dark olive figure incorporating the more intense black spots on each of the plastral scutes.

Measurements in mm: Length of carapace, 182; width of carapace, 135; depth of carapace, 82; length of plastron, 168; greatest width of plastron, 93.5; width of head, 31.5; length of head, 45.

Variation: The chief differences are those that occur between young and adult specimens. In the young the carapace is rather flattened with a strong vertebral keel and 2 small lateral keels; the laterals are completely lost in the adult, and the vertebral keel is more or less evident. In adults the carapace is much deeper proportionally without trace of dorsal flattening. It is distinctly convex.

The first vertebral scute is broader behind than in front in the young; in the adult they may be the same, front and back, or the front may be wider. The skin on the back of the head may be smooth, unbroken, or there may be a few large scutes indicated.

Distribution: In Thailand the species is widespread in lowland streams, lakes and swamps. Specimens have been taken in the province of Chiang Mai. I presume it is not especially rare. I have seen other specimens, these lacking exact locality data.

Outside of Thailand the species is spread from southern Burma, Indo-China, and Malaya, to the Indo-Australian Archipelago. It reaches the Philippines and Celebes. The type-locality is the Island of Amboyna (Ambon).

Genus **Heosemys** Stejneger

Geoemyda Gray, Proc. Zool. Soc., 1834, p. 100 (type of genus, *Testudo spengleri* Gmelin); Boulenger, Catalogue of the chelonians, rhynchocephalians, and crocodiles in the British Museum (Natural History), 1899, p. 186; The Fauna of British India, including Ceylon and

Burma. Reptilia and Batrachia. 1890, p. 24 *(part.)*; Stejneger, Proc. Biol. Soc. Washington, vol. 15, 1902, p. 238; Siebenrock, Zool. Jahrb., Suppl., Band 10, 1909, p. 494 *(part.)*.

Geomys Bonaparte, Tavola Analitica dei Chelonii 1836, p. 36.

Nicoria Gray, Catalogue of the shield reptiles in the collection of the British Museum, Part 1, Testudinata (tortoises), 1855, p. 17; Boulenger, Catalogue of the chelonians. . . . 1899, p. 118; The Fauna of British India. . . . 1890, p. 26 *(part.)*.

Melanochelys Gray, Proc. Zool. Soc. London, 1869, p. 187 (type of genus, *Geoemyda trijuga* Schweigger).

Chaibassia Theobald, Descriptive catalogue of the reptiles of British India, Calcutta, 1876, p. 6 (type of genus, *Geoemyda tricarinata* Blyth).

Heosemys Stejneger, Proc. Biol. Soc. Washington, vol. 15, 1902, p. 238 (type of genus, *Geoemyda spinosa* (Bell)).

Diagnosis: Skin of head hard, smooth or broken into scales posteriorly. Plastron widely united to carapace by a suture; axillary and inguinal buttresses present, extending to outer margins of costal plates; entoplastron usually intersected by the humeropectoral suture; no median ridge on alveolar surface of jaws; neural plates, except first, narrowed posteriorly. Skull with or without a bony temporal arch (variable during lifetime).

This genus is cosmopolitan, occurring also in the Western Hemisphere in Central and South America. Annandale (1923a) and M. A. Smith (1931a) have shown that one character in the genus, formerly used for generic separation, is useless. This was the presence or absence of a complete temporal arch. Both of these authors show that although at some stage the arch may be present it begins to become thinner and narrower. Then the quadratojugal may disappear; later the postorbital, and the jugal, and only a slight process may mark where these bones were present. This is indeed a curious reversal of the evolutionary process, or as called by Smith, *devolution*.

Two species of *Heosemys* are certainly endemic in Thailand, *H. spinosa* (Bell), and *H. grandis* Gray.

Key to Species of *Heosemys* in Thailand

1. Anterior margin of the shell serrated; second vertebral scale as broad as second costal, much broader than long ..... *spinosa*
2. Anterior margin of shell not serrated; the second vertebral narrower than second costal, not or but slightly broader than long ..... *grandis*

Heosemys spinosa Bell, *in* Gray

Emys spinosa Bell, *in* Gray, Illustrations of Indian Zoology, 1830, pt. 1, pl. 6; Synopsis reptilium or short descriptions of the species of reptiles, 1831, p. 20 (type-locality, Penang).

Geoemyda spinosa, Gray, Proc. Zool. Soc., 1834, p. 100; Illustrations of Indian Zoology, 1835, vol. 2, pl. 57; Boulenger, Catalogue of the chelonians rhynchocephalians and crocodiles in the British Museum, 1889, p. 137; Fauna of British India, including Ceylon and Burma. Reptilia and Batrachia. 1890, p. 35; S. Flower, Proc. Zool. Soc. London, 1899, p. 614; Ridley Jour. Straits Branch Roy. Asiatic Soc., No. 32, 1899, p. 185; Boulenger, Fasciculi Malayenses, pt. 1, 1903, p. 144; M. Smith, The fauna of British India including Ceylon and Burma. Reptilia and Amphibia. vol. 1, Loricata, Testudines, 1931, pp. 91-94, figs. 17a, b; Mertens and Wermuth, Zool. Jahrb. (Syst.), Jena, 1955, Band 83, Heft 5, p. 353.

Heosemys spinosa, Siebenrock, Zool. Jahrb. (Syst.), Jena, 1909, Suppl. 10, p. 506.

Diagnosis: Tail short, lacking elongated spines at its base; no bony temporal arch. Carapace with single median keel; upper jaw notched. Anterior margin of shell serrated; second vertebral shield at least as broad as second costal, much broader than long.

Description of species: A medium sized turtle with arched carapace in young, bearing a strong median keel, and each costal scale bearing a small rather sharp spine near its posterior edge. Carapace about as broad as long, strongly serrate all around carapace; marginals terminating in a dull spine, or sometimes with a double spine. Nuchal small.

The carapace of adult animal much depressed, with a flattened vertebral region and a well-defined keel; costal spines usually lost. Margin of carapace less strongly serrate; first vertebral scute broader than long, narrowed anteriorly; the following vertebrals all much wider than long, equally or nearly as broad as costals. Plastron as long as carapace, angled rather than rounded posteriorly; posterior lobe of plastron as well as anterior somewhat narrower than opening of carapace; posterior lobe strongly notched. Longest median suture of plastral scutes between abdominals or pectorals (nearly equal but usually the former); length of other sutures diminishes in following order: femoral, humeral, gular, anal. Plastron attached directly to marginals, bridge more than a third length of plastron.

The head relatively small; snout about as long as orbit of eye, terminally truncate. Edge of jaw with two denticulations. No temporal arch in skull. Skin of head partially squamate posteriorly.

Arms with enlarged, more or less imbricating scales, on anterior face; legs more or less club-shaped in adults, less so in young, with enlarged scales on anterior and posterior margins. Under surface of foot scaled. Fingers half webbed, toes less so. Back of thighs and part of anal area with small scales or conical tubercles. (Description from literature.)

Color: Generally brownish with a median lighter line or streak. Plastron and underside of marginals yellowish with radiating lines. Head grayish or brownish with yellow spot near the tympanum; occasionally, specimens with yellowish longitudinal lines. Small yellowish spots on limbs.

Measurements in mm: Total length, 225; width, 162; height of shell, 82.

Remarks: In Thailand the species is distributed chiefly in the rivers of mountainous areas in the peninsula. It feeds largely on aquatic vegetation.

The species is also known from southern Burma, Malaya, and the more western islands (Borneo and Sumatra) of the Indo-Australian Archipelago.

Heosemys grandis Gray

(Fig. 4)

Geoemyda grandis Gray, Ann. Mag. Nat. Hist., ser. 3, vol. 6, 1860, p. 218 (type-locality, Cambodia); Günther, Reptiles of British India, 1864, p. 19, pls. 1, 2; Boulenger, Catalogue of the chelonians, rhynchocephalians, and crocodiles in the British Museum (Natural

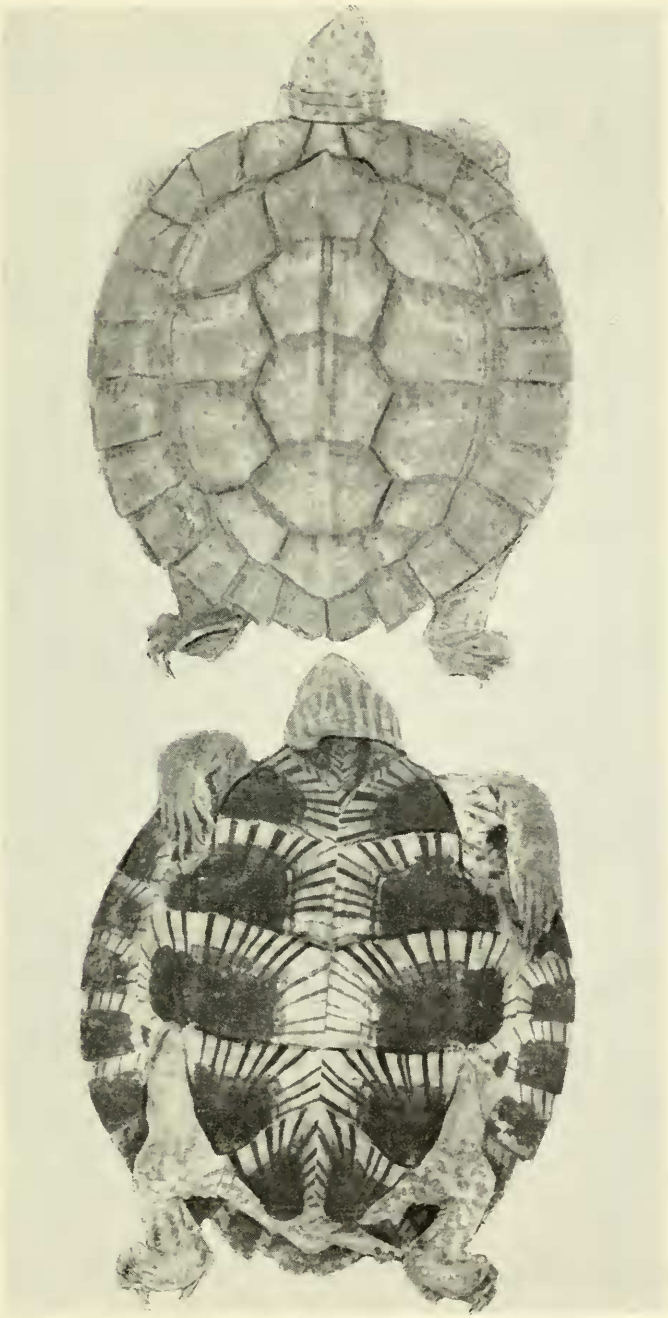

Figure 4. *Heosemys grandis* Gray. Chulalongkorn Univ. No. 1590, Bhetong, Yala, Thailand. Length of carapace, 110 mm; width of carapace, 104. Upper figure, dorsal view; lower, ventral view.

History), 1889, p. 138; Fauna of British India including Ceylon and Burma, Reptilia and Batrachia, 1890, p. 25, figs. 7 & 8; M.A. Smith, The fauna of British India, including Ceylon and Burma. Reptilia and Amphibia, vol. 1, Loricata, Testudines, 1931, pp. 101-103, figs. 20, 21; Mertens and Wermuth, Zool. Jahrb., Syst., Band 83, Heft 5, 1955, p. 350.

Diagnosis: Anterior margin of shell not serrate; second vertebral not or scarcely broader than second costal. No bony temporal arch.

Description of species (largely from no. 1641, Bhetong, Yala, Thailand): Carapace subcircular, about as broad as long, somewhat depressed in young but with median keel. Shell arched in adults; anterior edge of carapace not serrate; posterior edge somewhat serrate and slightly bent down. Eleven marginals on each side, a pair of supracaudals and a single small, but well-defined nuchal.

Five vertebral shields, first as long as wide (or sometimes longer), narrowed somewhat anteriorly, the shields following about as long as broad, not or but slightly narrower than costals; plastron nearly as long as carapace, extending slightly farther forward than carapace but shorter posteriorly; posterior section narrower than shell opening, a little shorter than bridge. Sutures of plastron vary, the longest between abdominals, the shortest between humerals or gulars. Axillary and inguinal shields present.

Head not especially small; snout as long as the diameter of eye, scarcely reaching beyond mouth; upper jaw bicuspid. No bony temporal arch. Skin of posterior part of head more or less broken into irregular shields. Enlarged scales on front of arms and posterior part of legs; digits webbed; tail short.

Color: Variable, but usually shell brownish above with slight or practically no variegation; ventrally, shields pale yellowish, each with a large dark (blackish) area, with numerous marks radiating from posterior part of shield. Ventral part of marginals similarly marked. Exposed skin of limbs greenish gray with flecks or vermiculations. Top of head greenish gray with occasional pinkish marks.

Measurements in mm of young: Total length of carapace, 110; width of carapace, 104; head width, 20.

Distribution: The species occurs along the Burma (Tenasserim)-Thai border ranging as far north as Pegu in Burma. Most Thai specimens, however, are from peninsular areas. It is known to occur in the northern states of Malaysia.

The species is probably the largest Asiatic member of the genus. Malcolm Smith reports a specimen from the Burmese-Thai border having a carapace 435 mm long.

Genus **Malayemys** Lindholm

Damonia (*non*-Robineau-Desvoidy) *(part.)* Gray, Proc. Zool. Soc. London, 1869, p. 193 (type of genus, *D. macrocephala*).

Malayemys Lindholm, Zool. Anz., Band 97, Dec. 1, 1931, no. 1, 2, p. 29 (new name for *Damonia*, Gray).

Diagnosis: Second neural plate short-sided in front, third octagonal, fourth and fifth short-sided behind; plastron extensively united to carapace by suture, with strong axillary and inguinal buttresses which extend to outer extremities of costal plates. Entoplastron anterior to humeropectoral suture; skull with bony temporal arch formed chiefly of quadratojugal, which contacts the maxillary bone; jugal small, almost or completely excluded from orbit. Alveolar surface of jaws very broad, without median ridge; bony choanae on a level with posterior margin of orbit. Skin of hinder part of head divided into small shields. Digits fully webbed. Tail very short.

Only a single species is recognized.

Malayemys subtrijuga Schlegel and S. Müller *in* Temminck

(Fig. 5)

Emys trijuga (not of Schweigger) Schlegel, Fauna Japonica. . . . Reptilia, 1833, p. 64 (type-locality, Java).

Emys subtrijuga Schlegel and S. Müller, *in* Temminck, Verh. Nat. Ges. Ned. Indie, Rept., 1844, p. 30.

Damonia subtrijuga, Boulenger, Catalogue of the chelonians, rhynchocephalians, and crocodiles in the British Museum, 1889, p. 94; Flower, Proc. Zool. Soc. London, 1899, p. 610; M. Smith, The fauna of British India, including Ceylon and Burma. Reptilia and Amphibia. vol. 1, Loricata, Testudines, Mar. 1931, pp. 105-106, figs. 22 (skull), 23 (shell).

Geoclemys subtrijuga, Siebenrock, Zool. Jahrb. Jena, Suppl. 10, 1909, p. 476.

Geoclemys macrocephala Gray, Proc. Zool. Soc. London, 1859, p. 479, pl. 21 (type-locality, Siam).

Emys nuchalis Blyth, Jour. Asiat. Soc. Bengal, vol. 32, 1863, p. 82 (type-locality, Java?).

Damonia oblonga Gray, Ann. Mag. Nat. Hist., ser. 4, vol. 8, 1871, p. 367 (type-locality, Batavia).

Damonia crassiceps Gray, Supplement to the catalogue of the shield reptiles in the collection of the British Museum, pt. 1, Testudinata, 1870, p. 43 (type-locality, China).

Malayemys subtrijuga, Lindholm, Zool. Anz., Leipzig, Bd. 97, 1931, p. 29 (new name for *Damonia,* preoccupied); Mertens und Wermuth, Zool. Jahrb. (Suppl.), Band 83, Heft 5, 1955, p. 360.

Diagnosis: Tricarinate carapace; keels retained more or less throughout life; lateral keel not extending across fourth costal; head large; yellow lateral stripes on head and neck; carapace brown with dark spots on marginal sutures, strongly pronounced on their ventral surface and spreading over half of the scute; plastral scales each with a large dark area; no scutes on tail; back of head with 15-20 small scales.

Description of species (from No. 33675, Bangkok): Medium-sized, carapace length reaching 210 mm; carapace moderately arched, somewhat depressed; discontinuous keels evident, tending to form slight knobs at posterior point of scales; nuchal scale relatively large, more than one and a half times as long as wide, projecting slightly beyond front border of adjoining marginals; measurements in mm of dorsal scutes (length x width): vertebrals, first, 42 x 34 mm, wider behind than anteriorly; second, 37 x 37 mm; third, 34 x 43 mm; fourth, 31 x 49 mm; fifth, 40 x 51 mm; costals: first, 53 x 52 mm; second, 38 x 60 mm; third, 40 x 58 mm; fourth, 40 x 41 mm (measurement

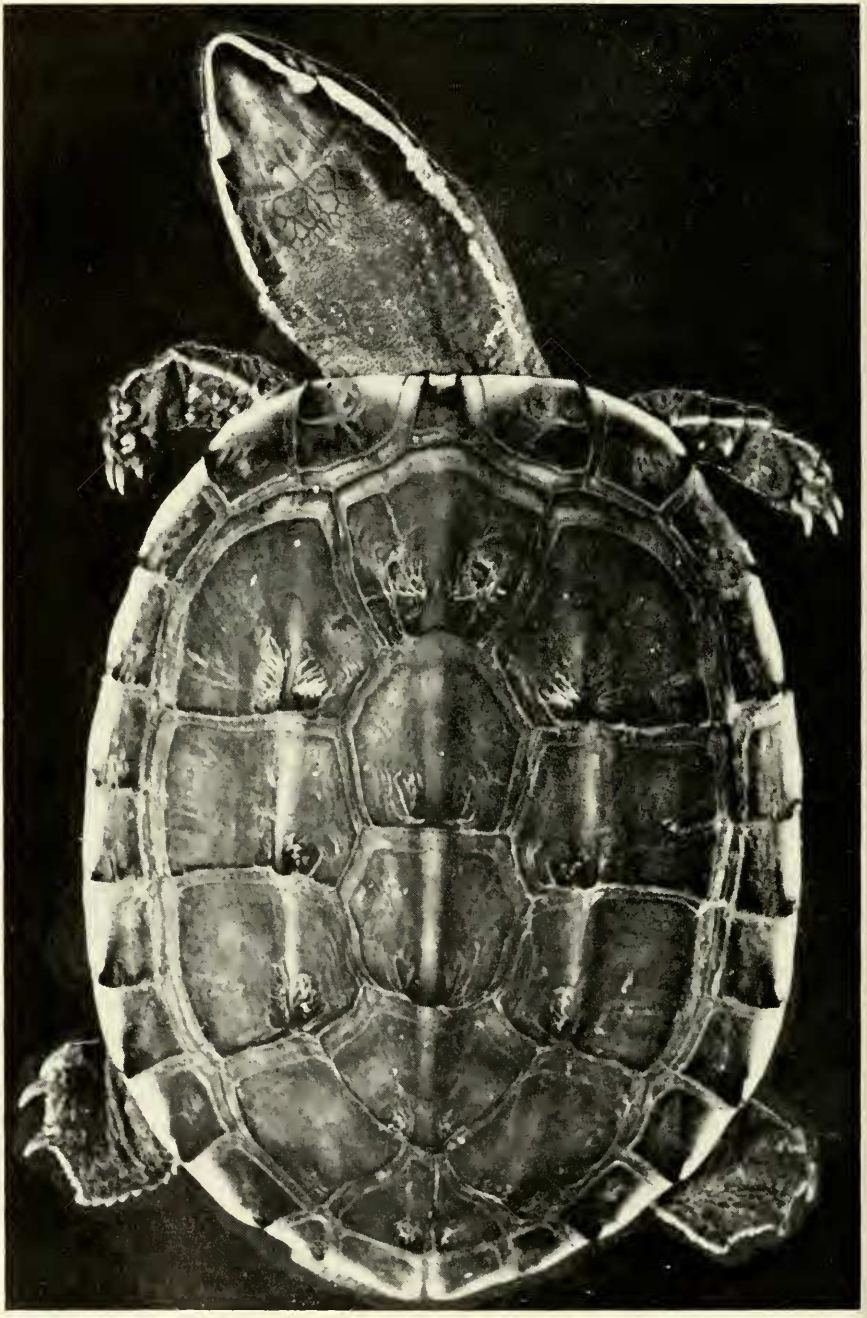

FIGURE 5. *Malayemys subtrijuga* (Schlegel and Müller *in* Temminck), Chulalongkorn Univ. No. 33675. Bangkok, Thailand. Carapace length, 204 mm.

made at widest [or longest] part of scale); supracaudal scales tectiform, notched slightly behind. Plastron distinctly shorter than carapace, truncate anteriorly, outer tip of each gular pointed, the point short, directed forward; strongly notched on posterior border; a broad bridge; plastral edge not or scarcely angular; length of bridge (67 mm) a little longer than posterior lobe of plastron (61 mm). Measurements in mm of median sutures of plastral scutes: gular, 19; humeral, 20; pectoral, 24; abdominal, 46; femoral, 25; anal, 24.5. Axillary and inguinal scales relatively large.

Front face of forearm with transversely widened scutes, usually separated by smaller scales not imbricating; upper edge of arm with row of 4 large scales; back face of forearm with a row of scales partly crossing arm transversely and 1 or 2 others adjoining these; toes fully webbed, claws moderate; leg with a double row of small scales bordering outer posterior edge of foot; posterior region of thighs and area above tail with a few conical scales surrounded and separated by fine, sharply pointed scales, some of these bearing 2 or 3 sharp spines, all very small, almost microscopic; under tail 2 rows of flat scales diverging from tip, each scale bearing on its posterior edge 3 to 5 sharply pointed spines. Soles of feet and palms of hand with small rounded juxtaposed scales.

Head large, skin of top smooth and undivided anteriorly, posterior part broken up into 4 or 5 rows of small scales which extend on sides of head, larger ones anteriorly, smallest posteriorly. A very large scute behind eye, bordering upper jaw scute; snout projecting beyond mouth (6 mm); upper jaw notched but not "toothed" or hooked; scute on lower jaw followed by 2 somewhat enlarged scales, 1 on each side.

Color: Above, carapace dark brown of varying shades, the scales lighter brown at periphery; marginal scales with some blackish areas near sutures, but on ventral side of marginals triangular black spots; plastron pale yellow, each scute with a large black or black-brown area; pectorals and abdominals each with 2 spots (the second one being on the bridge); well-defined black marks on axillary and inguinal scutes. Head black; an ivory-white line from tip of snout above eye and ear area to base of neck; a second ivory line from behind nostrils down below eye, crossing jaw angle, more or less continuous with a line running back on neck; two parallel lines from nostrils to mouth, more or less continuous with lines crossing lower jaw; a small line from lower jaw to throat; soft parts olive-gray; limbs darker on upper surfaces.

Measurements in mm: (see Tab. 1).

Variation: In the young the keels are more distinct and there is a broken line of dots crossing the temporal area (No. 1625). The black marginal lines along the sutures pass below, where they may be slightly wider. The posterior part of the carapace is without or with only a suggestion

TABLE 1. Measurements in mm of *Malayemys subtrijuga*.

Number*	34484	33675	1625
Length of carapace	183	204	103
Width of carapace	146	146	94
Depth of shell	80	81	44
Length of plastron	159	163	101
Width of plastron at bridge	118	120	78
Width of anterior lobe	91	83	52.5
Width of posterior lobe	82.5	78	51
Width of head	47	42	26
Tail	8	13	9
Orbit	13	11.5	8
Snout	11.3	10	7.3

* 34484, Pattani; 33675, Chiang Mai; 1625 Ang Hin, Chon Buri.

of serration. The first vertebral is distinctly wider anteriorly than behind, the reverse of the condition in the adult; the projection of the nuchal is an individual character. This does not obtain in the other specimens examined. The color of the head may be brown, chestnut or dark olive in the adult.

Distribution: The species is probably to be found over the entire country of Thailand. Some 20 specimens were taken in the city of Chiang Mai in a small pond near the Railway Hotel. I have specimens from Pattani, in the southern part of peninsular Thailand, from Bangkok and from Chon Buri, southeastern Thailand.

Outside of Thailand it has been found in Indo-China. It is the common turtle of the klongs of Bangkok.

Remarks: The species is easily kept in small ponds. It feeds largely on small water animals, preferring molluscs, insects, and worms.

Genus **Hieremys** M. A. Smith

Hieremys M. A. Smith, Jour. Nat. Hist. Soc. Siam, vol. 2, 1916, p. 50 (type of genus, *Cyclemys annandalii* Boulenger); Mertens und Wermuth, Zool. Jahrb. (Syst.), Band 83, Heft 5, 1955, p. 357.

Diagnosis: Plastron united to the carapace by sutures. Temporal arch incomplete, most of the quadratojugal being absent. Alveolar surfaces of jaws not narrowed, lacking median ridge. Skin of posterior part of head not forming scutes.

The second neural plate hexagonal, with its short side on anterior border. The plates following have their short side posteriorly. Digits completely webbed.

The genus is known to contain only a single species, *Hieremys annandalii*.

Hieremys annandalii (Boulenger)

(Fig. 6)

Cyclemys annandalii Boulenger, Fasciculi Malayenses, Zoology, vol. 1, 1903, p. 142, pls. 7, 8

(type-locality, "Jalor, Patani"): A vertebrate fauna of the Malay Peninsula. . . . Reptilia and Batrachia 1912, pp. 19-20, fig. 6.

Hieremys annandalii, M. Smith, Jour. Nat. Hist. Soc. Siam, vol. 2, 1916, p. 50; M. Smith, The fauna of British India including Ceylon and Burma. Reptilia and Amphibia. vol. 1, Loricata, Testudines, Mar. 1931, pp. 107-109, figs. 24, 25; Mertens and Wermuth, Zool. Jahrb., Syst., Band 83, Heft 5, 1955, p. 357.

Diagnosis: Large turtle (carapace length to 450 mm); carapace much longer than broad, with median keel more or less retained in old adults; normally 5 vertebrals (rarely 6); hind lobe of plastron shorter than length of plastral bridge; longest median plastral suture between abdominals; relatively large axillary and inguinal shields; shortest median suture between humerals; tail short; head with narrow stripe from snout above eye and ear to neck.

Description of species (from No. 1684, Bangkok): Carapace with a single keel (rather low), convex (but not flattened) dorsally, much longer than wide (251 x 190 mm), posterior rim distinctly serrate, anterior rim almost smooth in adult. Nuchal present, sides nearly parallel to near tip; anterior vertebral wider anteriorly than posteriorly (56-40 mm), its length 47 mm, its posterior edge sinuous with a median notch; width x length (in mm) of second vertebral 58 (measured on curve) x 55, with a short anterior median projection; third, 68 x 46, fourth, 62 x 44.5, last, 52 x 38. Costals: first 60 x 58; second, 66 x 45; third, 62 x 55; fourth, 40 x 44. Marginals not or but very slightly reverted; a notch between supracaudals.

Plastron nearly as long as carapace, somewhat angulate at least anteriorly on pectorals, not or scarcely emarginate on anterior end, deeply notched posteriorly; bridge wide, elongate, considerably longer than posterior lobe of plastron; median sutures between plastral scales with the following lengths in mm: gulars, 36; humerals, 19; pectorals, 43; abdominals, 52; femorals, 44; anals, 25. Inguinal large with a row of small scales bordering it behind; axillary also relatively large.

Arms not especially flattened, webbed to base of claws; entire front face from elbow covered with juxtaposed or slightly imbricate transverse scales larger near the upper surface; posterior surface likewise with transverse enlarged scales larger toward the upper part; a single row on upper surface with scales as long as wide; legs more flattened, heel area above and below with transversely widened, somewhat imbricate scales; sole of foot and palm of hand covered with flat juxtaposed scales. Tail short, upper surface of head not divided into scales but somewhat creased; beak with a median and 2 lateral notches; margin of lower jaw with strong denticulations, median ones largest.

Color: Carapace black, nearly uniform; inner edges of marginals on ventral face pale yellow; plastral scales with large blackish areas on pale yellow ground-color; the black area suggests irregular radiating blackish marks; arms and legs dark gray on upper surfaces, lighter gray below.

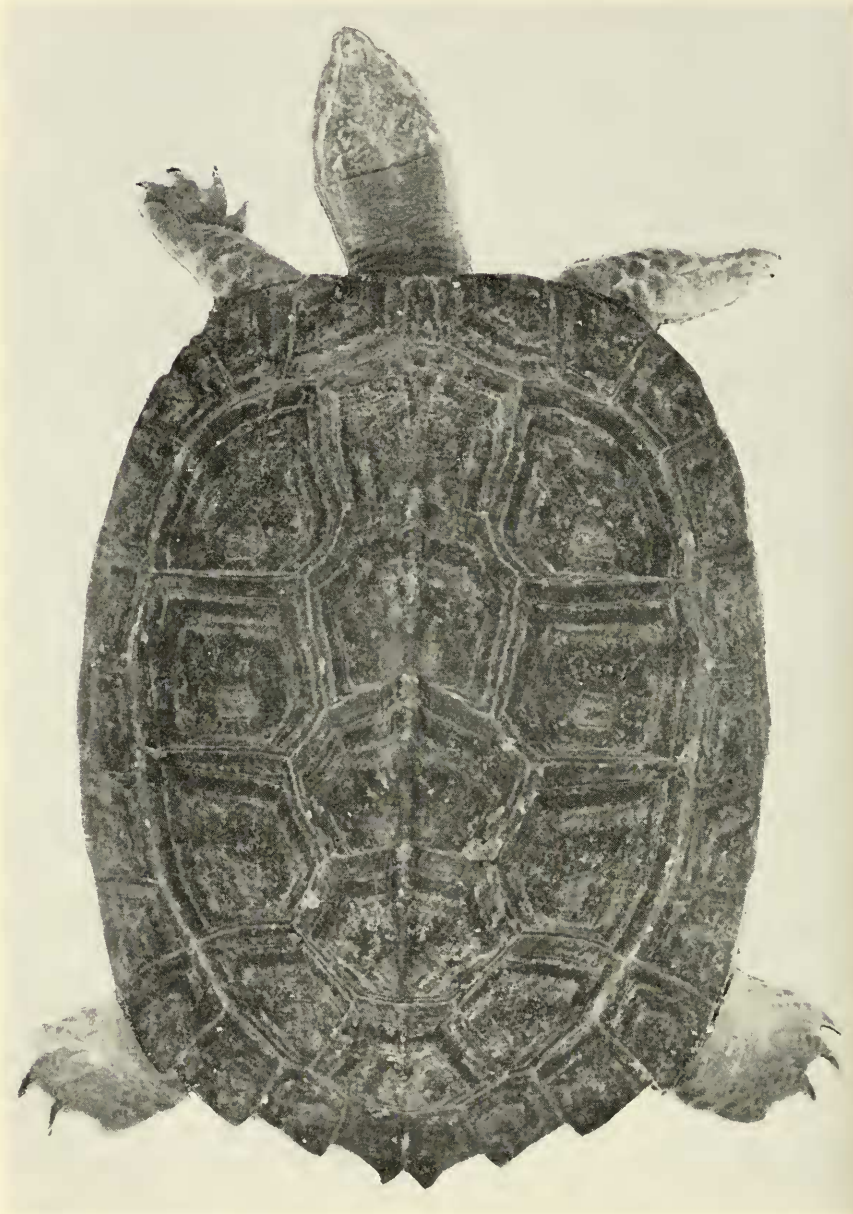

FIGURE 6. *Hieremys annandalii* Boulenger. Chulalongkorn University, No. 1684, Bangkok, Thailand. Carapace length, 242 mm.

Head blackish, flecked or marked with gray. A narrow whitish mark from upper tip of snout, above eye and ear, to side of neck; a broader light line on neck above this, terminating in a triangular spot on temporal region; front of snout and upper jaw whitish; lower jaw whitish with a black mark along jaw angle. Top of neck grayish proximally, darker brownish-black more distally; throat dull white; chin similar with a few darker flecks.

Measurements in mm: Length of carapace, 242; width of carapace, 187; depth of carapace, 93; length of plastron, 230; greatest width of plastron at bridge, 147; width of anterior plastral lobe, 116; width of posterior lobe, 102; length of bridge, 93; length of posterior lobe, 87; width of head, 37; length of head, 56; tail, 27.

Variation: The carapace is more depressed in the young than in the adult, proportionally shorter and with the keel much more distinct. The posterior margin, in the adults, varies. In some the strong juvenile serrations are retained; however, in the oldest specimens the serrations may be obsolete. Occasional specimens have 6 vertebral scales, 1 intercalated between the fourth and fifth. The vertebral scales are broader than long in the young, about as broad as long in the adults, usually narrower than costals; in young specimens the plastron is somewhat angulate. The snout is usually shorter than orbit, projecting somewhat beyond the lower jaw.

The plastron may be entirely black. The soft parts may be greenish gray. In older individuals the dark streaks usually disappear, the head becoming gray with yellowish or greenish vermiculations. The jaws are greenish in many specimens.

Distribution: In Thailand the species is known in the peninsular area and in the central region. Specimens I have examined have been taken chiefly from the river at Bangkok. The species has also been taken in Narathiwat and Pattani Provinces. It is known in Malaya and specimens have been taken in Cambodia.

Remarks: The species readily takes fruit and waterplants and most green garden truck and vegetables. This is their staple diet at the Dusit Zoo in Bangkok. Many may be seen at the Tortoise Temple in Bangkok. Of this Malcolm Smith (1931a) writes: "Numbers of them are usually to be seen in the Tortoise Temple in Bangkok, an honour which they share with *Geoemyda grandis,* a species of much the same size and general external features. No particular form of worship is attached to these tortoises. They are presented to the temple in accordance with the tenets of the Buddhist religion, by which a life saved gains merit for the saver in the next world. Having saved the life of the tortoise the obligation ceases, and no particular care is taken of them in the temple afterwards."

Genus **Notochelys** Gray

Notochelys Gray, Proc. Zool. Soc. London, 1863, p. 177 (type of genus, *Emys platynota* Gray).
Cyclemys (part.), Boulenger, Catalogue of the Chelonians . . . in the British Museum, 1889, p. 129.

Diagnosis: The plastron with a distinct bridge attached to carapace by ligamentous tissue rather than by suture. Hexagonal neural plates with their short side anteriorly. An indistinct, more or less movable hinge between hyoplastron and hypoplastron; entoplastron intersected by the humeropectoral suture. A complete temporal arch, or partial temporal arch if postorbital or quadratojugal is lost. Alveolar jaw surfaces narrowed. Fingers and toes completely webbed. Carapace flattened with a more or less continuous median keel.

Only a single species, *Notochelys platynota* Gray, is known. It has a southeastern Asiatic distribution. It is known to occur in southern Thailand, Cochin China, Malaya, and the Indo-Australian Archipelago. Smith (1931a) reports that the record originally given by Gray for Tenasserim is in error.

I have not encountered this species and the description here included is from the literature.

Notochelys platynota Gray

Emys platynota Gray, Proc. Zool. Soc. London, 1834, p. 54; Illustrations of Indian Zoology, 1834, vol. 2, pl. 57 (type-locality, Sumatra).
Cyclemys platynota, Boulenger, Catalogue of the chelonians, rhynchocephalians, and crocodiles in the British Museum, 1889, p. 130; The fauna of British India, including Ceylon and Burma. Reptilia and Batrachia. 1890, p. 30; Flower, Proc. Zool. Soc. London, 1899, p. 612.
Notochelys platynota, Siebenrock, Sitzb. Akad. Wiss. Wien, Band 112, 1903, p. 344; Zool. Jahrb., Suppl. Band 10, 1909, p. 504; M. A. Smith, The fauna of British India, including Ceylon and Burma. Reptilia and Amphibia. vol. 1, Loricata, Testudines, 1931, pp. 110-111; Mertens und Wermuth, Zool. Jahrb. (Syst.), Band 83, Heft 5, 1955, p. 361.
Cyclemys giebelii Hubrecht, Notes Leiden Mus. vol. 3, 1881, p. 45 (type-locality, Banka, Borneo).

Description of species: A rather small turtle, the length of carapace probably not exceeding 340 mm; slightly wider carapace, relatively flat with a more-or-less developed median keel, sometimes discontinuous; anterior margin serrated in young but not in adults; posterior margin serrate throughout life. Carapace margin with 11 marginals on each side, 2 posterior supracaudals and a small median anterior nuchal. Six (or 7 rarely) vertebral shields, broader than long and narrower than costal shields.

A distinct bridge between plastron and carapace; plastron shorter than carapace and narrower than its opening, truncate or emarginate anteriorly and posteriorly, the length of posterior lobe as great as width of bridge. Longest median suture of plastron between abdominal or pectoral shields; shortest suture between humerals or femorals. Axillary shield small or sometimes absent, inguinal shield relatively large.

The snout about length of orbit, projecting beyond mouth; upper jaw

bearing two cusps. Back part of head with small shields; hands and feet fully webbed.

Color: Color and markings of shell variable. The young usually chestnut brown with 2 dark spots on each vertebral shield, 1 on each costal shield. Adults brown or reddish brown, yellowish on plastron, each shield with a black or brown spot. In very old specimens, areas may be almost completely dark. Head and neck dark, brownish or blackish with yellow streaks, those behind eyes most conspicuous. These markings may be wanting in old specimens.

Dimensions: Malcolm Smith (1931a) reports a specimen with a length of 320 mm; width, 230 mm; height, 92 mm.

Remarks: The species is known to occur in Thailand chiefly in the peninsular portion of the country.

Genus **Siebenrockiella** Lindholm

Bellia (not of Milne-Edwards 1848), Gray, Proc. Zool. Soc. London, 1869, p. 197, type, *Emys crassicollis* (Gray).

Siebenrockiella Lindholm, Zool. Anz., Leipzig, Band 81, Heft 11/12, 1929, p. 280 (type *Emys crassicollis* (Gray)).

Diagnosis: Hexagonal neural plates short-sided in front. Plastron extensively united to carapace by suture with strong axillary and inguinal buttresses which extend to outer extremities of costal plates; entoplastron intersected by a humeropectoral suture. Skull with bony temporal arch, the quadratojugal being in contact with jugal and postorbital. Alveolar surfaces of jaws narrow, without median ridge; bony choanae on level with anterior half of orbits. Skin of hinder part of head divided into small shields. Digits fully webbed. Tail short. From M. Smith (1931a).

Only a single species is recognized in this genus.

Siebenrockiella crassicollis (Gray)

Emys crassicollis Gray, Illustrations of Indian Zoology, 1831, pl. 76; Synopsis reptilium or short descriptions of the species of reptiles, Part 1, *Cataphracta* tortoises, crocodiles and enaliosaurians, 1831, p. 21 (type-locality, Sumatra); Günther, The reptiles of British India, 1864, p. 28, pl. 4; Morice, Coup d'oeil fauna Cochinchine, 1875, p. 63.

Bellia crassicollis, Gray, Proc. Zool. Soc. London, 1869, p. 197; Boulenger, Catalogue of the chelonians, rhynchocephalians, and crocodiles in the British Museum, 1889, p. 981; The fauna of British India. . . . 1890, p. 32; Siebenrock, Zool. Jahrb., Jena, Suppl. 10, 1909, Heft 3, p. 478; Annandale, Rec. Ind. Mus., vol. 11, 1915, p. 194.

Siebenrockiella crassicollis, Lindholm, Zool. Anz., Band 81, Heft 11/12, 1929, p. 280; M. Smith, The fauna of British India including Ceylon and Burma. Reptilia and Amphibia. vol. 1, Loricata, Testudines, 1931, pp. 112-114, fig. 26 and pl. 1, fig. 1; Mertens und Wermuth, Zool. Jahrb. (Syst.), Band 83, Heft 5, 1955, p. 367.

Emys nigra Blyth, Jour. Asiat. Soc. Bengal, vol. 24, 1855, p. 713 (type-locality, Tenasserim).

Pangshura cochinchinensis Tirant, Notes sur les reptiles et les batraciens de la Cochinchine et du Cambodge, Saigon, 1885, p. 15 (type-locality, Cochin China).

Diagnosis: Generic characters. The vertebral shields are narrower poste-

riorly than anteriorly, except fifth. Second with an hemispherical front portion. Five claws on hand, 4 on feet.

Description of species (from No. 1714, Bangkok): Carapace with 3 keels, median distinct; lateral keels better indicated in young; nuchal subtriangular pointed, anteriorly widened, posterior edge concave; first vertebral widened anteriorly, much narrowed posteriorly; second with front edge rounded, much narrowed posteriorly; third a little wider on anterior edge than on posterior; fourth narrowed anteriorly and posteriorly; fifth much narrowed anteriorly, much widened posteriorly, the posterior border concave. Length and width of vertebrals in mm: first, 33 x 25; second, 29 x 33; third, 28 x 33; fourth, 30 x 35; fifth, 36 x 43. Twelve pairs of marginals including supracaudals which are larger than the 3 marginals on each side preceding them; costals wider than long, very much wider than vertebrals.

Carapace somewhat narrowed anteriorly with a rather distinct lateral keel; posterior marginals serrate.

Plastron smaller than opening of shell; a distinct lateral keel terminating on femorals posteriorly, and in a slight rounded lateral projection anteriorly; front edge of plastron truncate, broadly notched with blunt anterolateral points, a semicircular notch behind. Plastron attached to carapace by suture, its greatest width 94 mm; greatest width of carapace, 127 mm; median sutures of plastral elements measure (in mm): gulars, 17.2; humeral, 11.5; pectoral, 25.4; abdominals, 33; femoral, 24; anal, 19. Axillary and inguinal shields present; tail short.

Head broad, rather large, snout shorter than orbit, rounded, and slightly projecting; upper jaw emarginate; posterior surface of head broken into small shields; a narrow strip of granular shields from eye to tympanum and between shield of lower jaw and tympanum; diameter of tympanum equal to that of orbit.

Arms with 5 clawed fingers, fully webbed; front face of lower arm with transversely widened subimbricate shields; upper arm surface with a row of enlarged scales, posterior face with 3 enlarged shields and about 12 on palm somewhat enlarged.

Foot fully webbed; 4 toes bearing claws, outer without claw. On upper anterior surface of foot 4 or 5 tubercular shields, not touching each other; heel with transversely widened scales on front and posterior face of leg.

Color: Carapace black above, nearly uniform; plastron light horn-color with large blackish areas on each plastral scute; anals nearly entirely dark; underside of marginals black and yellowish. Arms and legs blackish; upper surface of tail blackish.

Head with an indistinct light area behind eye and on tympanum; edge of upper jaw yellowish; remainder of upper side of head black. Chin and throat dirty whitish.

Measurements in mm: (see Tab. 2).

Table 2. Measurements in mm of *Siebenrockiella crassicollis* (Gray).

Number*	1713	1714	1715	1716
Sex	♂	♂	♂	♀
Carapace length	170	196	176	182
Carapace width	129	143	136	142
Plastral length	129	156	143	155
Plastral width, greatest	94	108	105	109
Greatest width of posterior lobe	73	79	76	85
Tail length	13	16	16	13
Width of head	35.5	39	36.5	41

* All from Bangkok.

Variation: No. 1715 has the last vertebral split on one side thus making 5 costals on the left side. This specimen is black on the underside save for a few small yellowish spots on marginals and a rather large continuous yellowish area on the middle of the plastron. One of the specimens has the skin on the crown of the head as well as that of the posterior part divided into small scutes. The lateral plastral keel is more poorly developed in the female specimen. The head markings differ in being more distinct and of a yellowish-white color, despite the fact that it appears to be an old specimen. The carapace tends to be narrowed anteriorly, probably less so in the female.

Distribution: In Thailand the species is common in the rivers and at least in larger ponds. Since it is in northern Malaya and Tenasserin in Burma, one would expect to find it throughout the peninsular area. It is known in Sumatra and Borneo.

Genus **Batagur** Gray

Batagur Gray, Catalogue of the shield reptiles in the collection of the British Museum, Part 1, Testudinata (tortoises), vol. 1, 1855, p. 35, pl. 16; Supplement to the catalogue of shield reptiles in the collection of the British Museum, Part 1, Testudinata 1870, pp. 51-53, fig. 18 (type of genus, *Emys baska*).

Tetraonyx Lesson, Illustrations of Zoology, 1832, pl. 7 (type, *T. longicollis*). (Not of Latreille, 1809.)

Diagnosis: "Neural plates elongate hexagonal, short-sided in front. Plastron extensively united to carapace by suture, with extremely developed axillary and inguinal buttresses which extend nearly to neural plates. The former connected with first rib; entoplastron anterior to humeropectoral suture. Skull with a bony temporal arch, the quadrato-jugal being in contact with jugal and postorbital; bony alveolar surface of jaws very broad with two strongly denticulated ridges. Digits fully webbed with 4 claws only. Tail very short, not longer proportionately in the young than in adults. A single species." From M. A. Smith (1931a).

Batagur baska Gray

(Fig. 7)

Emys baska Gray, Illustrations of Indian Zoology, pt. 4, pl. 8, 1830 (vol. 1, pl. 75); Synopsis reptilium or short descriptions of the species of reptiles, Part I, Cataphracta, tortoises, crocodiles, and enaliosaurians, 1831, p. 24 (type-locality, India).

Batagur baska, Gray, Catalogue of the shield reptiles in the collection of the British Museum, Part I, Testudinata (tortoises), 1855, p. 35, pl. 16; Günther, Reptiles of British India, 1864, p. 37, pl. 3; Boulenger, Catalogue of the chelonians . . . in the British Museum 1889, p. 61; Fauna of British India. . . . 1890, p. 38; Siebenrock, Zool. Jahrb., Suppl. 10, Heft 3, 1909, p. 456; M. A. Smith, Fauna of British India. Reptilia and Amphibia. vol. 1, Loricata, Testudines, 1931, pp. 134-135, pl. 1, fig. 2; Mertens and Wermuth, Zool. Jahrb. (Syst.), Band 85, Heft 5, 1955, pp. 341-342.

Emys batagur Gray, Synopsis reptilium, 1831, p. 23; Illustrations of Indian Zoology, vol. 2, 1834, pl. 59 (type-locality, India).

Tetraonyx longicollis Lesson, Illustrations of Zoology, 1832, pl. VII (type-locality, Pegu); Anderson, Anatomical and Zoological researches and zoological results of the Yunnan Expeditions, Reptilia and Amphibia, 1879, p. 77.

Emys tetraonyx Schlegel, Fauna Japonica, 1834, p. 43 (substitute name for *longicollis*).

Tetraonyx lessoni Duméril and Bibron, Erpétologie Générale, vol. 2, 1835, p. 338, pl. 16 (substitute name for *E. batagur*).

Tetraonyx affinis, Cantor, Catalogue of Malayan Reptiles, 1847, p. 6 *(part.)*.

Diagnosis: Characters of the genus.

Description of species (from literature): A large species, carapace reaching half a meter in length with a width of about 440 mm. Carapace smooth, without a keel, somewhat flattened; nuchal shield present, broader than long; marginals not typically serrate; vertebrals variable in size and proportions, second and third about equal, and equal, in general, to the costals. Plastron smaller than opening of carapace, truncate anteriorly and with a posterior notch; bridge wider than length of posterior lobe. Plastral sutures vary, the abdominal sutures longest, gulars shortest. A large inguinal shield, axillary smaller.

Snout projecting, and somewhat turned up at end; skin of occipital region broken into scales. Neck superficially appears to be covered with fine scales. Shell brownish olive to olive-green, whitish or yellowish below. The color may vary during the breeding season.

Measurements in mm: Malcolm Smith (1931a) gives the measurements of a specimen as follows: Length, 590; width, 430; height, 210.

Remarks: This is probably the largest of the Asiatic hard-shelled aquatic turtles. It is reported that they are often seen in large numbers along river banks in India. Smith (1931a), states, "It inhabits estuaries, deep, slow-flowing rivers and canals. They lay from the beginning of January or a little earlier until the end of February or beginning of March. Every day, quite irrespective of the state of the tide, the tortoises come out of the sea and sun themselves on the sand from 2 P.M. till dark. They assemble in herds of from one hundred to five hundred lying quite close to one another. Every night some of them lay eggs, between 10 and 30 in number, in the sand of the beach, digging a hole for them from one and a half to two feet deep above

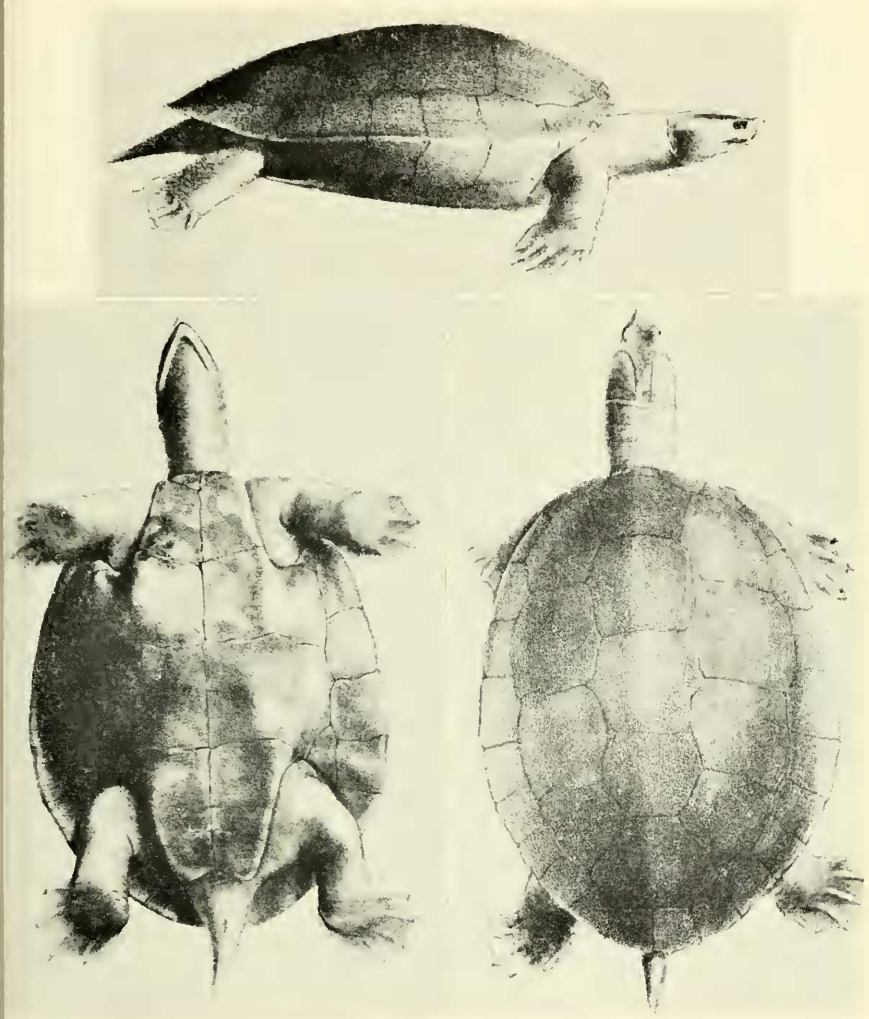

Figure 7. *Batagur baska* Gray. From Gray, "Catalogue of the Shield Reptiles, etc.," 1855, Pt. I, pl. 16.

the influence of the tides. On no consideration will the tortoises allow themselves to be approached: directly they wind a human being they disappear into the sea."

The period of incubation is said to be about 70 days. Altogether 50 to 60 eggs are laid by each female. They are deposited in 3 batches over a period of about 6 weeks time.

The species in Thailand would appear to be much less numerous than in India since they are not known to occur in numbers anywhere.

Smith's (1931a) plate 1, fig. 2, gives a splendid figure of the head, lateral view.

Family Testudinidae Gray

Testudinidae, Gray, Ann. Philos., ser. 2, vol. 10, 1825, p. 210.

Head and neck retractile; limbs somewhat club-shaped; a nuchal plate with riblike process (the scale, however, may be absent as in *Testudo elegans*); plastral and marginal shields not separated on sides. Nine bones in plastron.

Skull with a bony temporal arch; auricular cavity closed posteriorly by quadrate; temporal region not roofed by bone; digits 4 or 5; odoriferous musk glands absent.

The members of this family are typically terrestrial animals; apparently none has become aquatic. They are widespread on earth, the largest ones persisting on the Galapagos of the eastern Pacific Ocean, and on the Seychelles and Aldabra of the Indian Ocean. They are absent in Australia and New Guinea.

These turtles, at least certain of the larger species, are reputed to live to an age in excess of one hundred years. *Testudo leithi* of Egypt is the midget of the family, an old adult having a carapace usually less than 130 mm in length. Of the 4 known genera of the family, only the genus *Testudo* is known to occur in Asia.

Genus Testudo Linnaeus

Testudo Linnaeus, Systema Natura, ed. 10, 1758, p. 197 (type of genus, *Testudo graeca*=*T. ibera* Pallas).

Indotestudo Lindholm, Zool. Anz., Band 81, Heft 11/12, 1929, p. 285 (type of genus, *Testudo elongata*).

Diagnosis: Neural plates hexagonal, short-sided behind or alternately tetragonal or octagonal; costal plates alternately narrower and wider; plastron extensively united to carapace by suture with short axillary and inguinal buttresses which do not reach or just reach the costal plates; alveolar surface of upper jaw with a more or less well-developed median ridge. Choanae on a level with anterior half of orbits. Limbs more or less cylindrical. Legs club-shaped, partly covered with large bony scutes; digits short, unwebbed. Tail short. (Data from M. Smith, 1931a, p. 137.)

There are 3 species of this genus recognized as occurring in Thailand. They may be distinguished by the following key:

Key to Thailand Species of *Testudo*

1. Supracaudal shield single. Nuchal present (rarely absent); a broad suture between pectoral shields, equal to or larger than that be-

tween humerals; shell greenish yellow on carapace and plastron, each shield with a black spot. ..... *elongata*

Supracaudal shield double 2

2. Pectoral shields forming a median suture but shorter than that between other plastral scales; plastron not longer than carapace; nuchal scale rather large, triangular; shell light-brown often with radiating marks especially on plastron; dorsal part of carapace flat, the costals and some vertebrals concave ..... *impressa*

Pectoral shields widely separated; plastron longer than carapace; blackish- to dark-olive, the shields with horn-colored spots ..... *emys*

Testudo elongata Blyth

Testudo elongata Blyth, Jour. Asiat. Soc. Bengal, vol. 22, 1853, p. 639 (type-locality, Tenasserim); Gray, Proc. Zool. Soc., London, 1856, p. 181, pl. 9; Anderson, Zool. Res. W. Yunnan, 1879, p. 706; Boulenger, Catalogue of the chelonians, rhynchocephalians, and crocodiles in the collection in the British Museum, 1889, p. 173; Fauna of British India, . . . including Ceylon and Burma, 1890, p. 20; Siebenrock, Sitzb. Akad. Wiss, Wien, 112, 1903, p. 346; Annandale, Rec. Ind. Mus., vol. 11, 1915, p. 347; M. Smith, Fauna of British India, . . . vol. 1, 1931, pp. 141-143, fig. 29; Mertens and Wermuth, Zool. Jahrb. (Syst.), 1955, Band 83, Heft 5, p. 377.

Testudo parallelus Annandale, Rec. Indian Mus. vol. 9, 1913, p. 76 (type-locality, Chaibassa District, Chota Nagpur).

Diagnosis: Carapace elongate, reaching a length of about 300 mm. Generally yellow above and below, with large dark spots or flecks on dorsum. Larger dark spots on marginal scales. The supracaudal scale single. Top of head with symmetrical scales.

Description of species: Body strongly arched, length of shell about 1.66 times its width, 2.6 times it height; carapace flattened dorsally in adults; posterior and anterior borders of carapace bent down, then slightly reverting. Marginals somewhat serrate in young, not or scarcely so in old specimens.

Head of average size; well-defined pair of prefrontal shields; frontal shield single; occipital shield small; dorsolateral and lateral series of scales unequal, some considerably larger than others. Upper jaw tricuspid, the horny edge of jaw slightly denticulated. Nuchal shield elongate; first vertebral shield as long as broad, following ones broader than long; supracaudal somewhat recurved.

Arm with imbricating scales along outer part. Posterior part of foot with enlarged scales; enlarged scales on posterior part of thigh. Tail curving, ending in a large scale.

Carapace with an elongate nuchal (rarely absent); 5 vertebrals, all broader than long except first; 2 supracaudals, incurving. Plastron large, truncate anteriorly, notched posteriorly. Longest plastral suture between abdominals, shortest between anal pair, which may be completely separated. A small axillary and a larger inguinal shield.

Color: Carapace and plastron dull greenish or greenish yellow; a dark

spot on each scute of carapace, those on vertebrals small, irregular, those on marginals much larger; head greenish yellow; arms and legs with small dark spots.

Measurement in mm: Total length 275; width, 165; depth, 105 (from Malcolm Smith, 1931a).

Remarks: The nuchal shield may be absent. This form is wide-spread from northeastern India east to Cambodia and Vietnam, and south to upper Malaya (Penang). It is not rare in Thailand along the Burmese border.

These large terrestrial tortoises are usually found in hilly or mountainous areas, inasmuch as they are hunted as food in lower cultivated areas. In my own collecting, in large part done in lowland, I have never found a specimen.

The species is known chiefly from the Thailand-Burma border. If present in northern and eastern Thailand it must be much rarer.

A living specimen is pictured by Dr. Boonsong Lekagul (1966, p. 58). Two subgenera have been proposed that involve Thai species. Thus *Testudo emys* and *T. impressa* are in the subgenus *Manouria* and *T. elongata* has been placed in the subgenus *Indotestudo*. See Williams (1952).

Testudo emys Schlegel and S. Müller

Testudo emys Schlegel and S. Müller *in* Temminck, Verh. Nat. Gesch. Ned. Ind., Rept., 1844, p. 34, pl. 4 (type-locality, Sumatra); Anderson, Proc. Zool. Soc., 1872, p. 132-144, figs. 1 to 8; Boulenger, Catalogue of the chelonians, rhynchocephalians and crocodiles in the British Museum, 1889, p. 158 *(part.);* The fauna of British India, . . . Reptilia and Batrachia, 1890, p. 22; Flower, Proc. Zool. Soc. London, 1899, p. 616; Siebenrock, Zool. Anz., vol. 30, 1906, p. 583; Zool. Jahrb., Jena (Suppl), 10, Heft 3, 1909, p. 519; M. Smith, Jour. Nat. Hist. Soc. Siam, vol. 2, no. 2, 1916, p. 149 (Khao Wang Hip, Nakhon Si Thammarat); *idem,* vol. 4, no. 4, July 25, 1922, p. 205; Mell, Arch. für Naturgesch., Band 88 (10), 1922, p. 114. Mertens und Wermuth, Zool. Jahrb. (Syst.), Band 83, Heft 5, 1955, p. 377.

Manouria fusca Gray, Proc. Zool. Soc. London, 1852 (1854), p. 134 (type-locality, Singapore).

Manouria emys, Tirant, Notes sur les reptiles et les batraciens de la Cochinchine et du Cambodge, 1885, p. 12.

Testudo phayrei Blyth, Jour. Asiat. Soc. Bengal, vol. 22, 1853 (type-locality, Arakan, Tenasserim, Burma).

Diagnosis: Large species reaching a carapace length of 470 mm, a width of 340, mm, a depth of 195 mm. Carapace somewhat flattened in older specimens; part of anterior and posterior marginal shields recurved, lateral marginals vertical; pectoral shields widely separated from each other; 2 supracaudals. Abdominal scutes largest, suture between them nearly double other median plastral sutures; usually 2 inguinal shields; a group of subconical scales projecting from thighs posteriorly.

Description of species (from a living specimen in the Dusit Zoological Gardens, Bangok): Carapace broadly arching, dorsal surface somewhat flattened; part of shields concave, especially the posterior costals and some marginals; some anterior and posterior marginals recurved somewhat, more or less serrated; nuchal shield well developed, a little longer than broad; 24

marginals, lateral ones standing vertically; vertebral and costal scales broader than long; transverse suture between first 2 vertebrals tending to curve forward; between second and third, suture nearly straight; between third and fourth, suture sinuous with a median forward curve; between fourth and fifth, straight; supracaudal scale divided, curving downward sharply, not or scarcely notched.

Plastron a little longer than carapace; a small axillary and two inguinal scutes; notch between gular scales; humerals broadly in contact with abdominals thus separating pectorals by a distance of 123 mm. Abdominal scales very large, length of suture between them nearly twice that of other plastral shields; a wide notch between anal shields; front end of plastron extending beyond carapace.

Head moderately large, jaw not or only slightly hooked; top of head with a very large frontal scute preceded by 2 pairs of smaller scutes, and followed by a considerable number of smaller, more or less symmetrical scutes. Arms club-shaped, compressed, with 5 clawed digits, anterior (or outer if arm is folded) surface covered with thickened imbricate scutes arranged in several rows, but not entirely surrounding arm. Legs thickened, "club-shaped," with 4 clawed digits; foot somewhat rounded with 10 or 12 enlarged thickened bony scutes on sole of foot, 1 or 2 at posterior edge subconical; area on heel and about ankle with enlarged imbricating scales; scaleless area on posterior surface of thigh and a group of enlarged scutes, the posteriormost subconical, pointing backward, largest median one having a basal width of 23 mm and projecting 31 mm; the 2 scutes touching its sides somewhat smaller. Jaw slightly hooked but this not very obvious. Tail somewhat flattened at base with 8 or 10 pairs of supracaudal scales, and terminating in a grooved, spurlike tubercle.

Color in life: Above, carapace a shade of olive-black; vertebral and costal shields each with a rather large horn-colored area covering the central part; marginals, including nuchal and supracaudals each with a horn-colored mark on its central outer part; plastron largely yellowish with blackish areas, flecks or clouding; large scutes covering outer surface of arms and legs of varying shades of horn color often edged with a darker color or sometimes entire scale olive; skin on exposed surfaces of neck and limbs a dirty indefinite yellowish olive.

Measurements in mm:* Length of carapace, 455, 434; width of carapace, 315, 295; length of plastron, 463, 448; length of suture between gulars, 70, 72; suture between humerals, 88, 63; between abdominals, 173, 165; between femorals, 45, 50; between anals, 43, 33; length and width of vertebrals, first, 104-87, 118-88; second, 129-83, 110-75; third, 135-100, 110-86; width of nuchal,

* Measurements taken from the described form and another living specimen in the Bangkok Zoo (Dusit), respectively. I have not obtained accurate measurement of the head and legs of the latter.

28-22, length of nuchal, 31, 26; width and length of costals, first, 103-100, 120-108; second, 87-124, 96-130; third, 81-116, 86-119; fourth, 86-79, 93-82; tail, 52, 48.

Variation: The costal shields in the adult are not always concave. Sometimes the plastron is actually longer than the carapace. While the pectoral shields are usually separated, they rarely touch. The inguinal is sometimes single.

Some specimens are much darker than others; the second measured specimen is considerably darker than the one described. The horn-colored spots can be seen but they are very inconspicuous.

Remarks: These large turtles are now becoming rare in Thailand. They are seldom found except in more or less uninhabited hilly or mountainous districts. They are generally utilized as food throughout Thailand.

These turtles are herbivorous, and are said to be fond of water, which is not true of many species of the family Testudinidae. Some American desert forms are capable of going for weeks without water other than that which they manufacture in metabolism.

Testudo emys is the largest Asiatic species of the genus and it may readily be distinguished from other Thai species, *elongata* and *impressa,* by the separation of the pectoral shields from one another on the plastron. The division of the subcaudals, however, occurs also in *impressa* but not in *elongata.*

Both in Thailand and in Malaya the species is known as the six-footed-turtle because of the greatly enlarged conical scutes on the back of the thigh which simulate the rough scutes of a retracted foot. Boulenger (1912) states the Malay name is *kura kura anam kaki.*

Distribution: The species has been reported in Thailand from the province of Nakhon Si Thammarat but probably occurs in the mountain areas throughout the peninsular parts.

Outside of Thailand the species ranges in Burma, Assam, Malaya, Sumatra, and some smaller islands of the Indo-Australian Archipelago. M. Smith (1931a) questions the reports of Tirant (1885a) for Saigon: of Mell (1922a) for Canton, and of Siebenrock (1909) for the mouth of the Yang Tse Kiang.

This species is figured by Dr. Boonsong Lekagul (1966, pp. 57-58).

Testudo impressa (Günther)

(Fig. 8)

Geoemyda impressa Günther, Proc. Zool. Soc. London, 1882, p. 343, figs. 1-3 (type-locality, Siam).

Testudo impressa, M. Smith, Jour. Nat. Hist. Soc. Siam, vol. 4, no. 4, July 25, 1922, pp. 204-205; The fauna of British India including Ceylon and Burma. Reptilia and Amphibia. vol. 1, Loricata, Testudines, 1931, pp. 145-146; Mertens und Wermuth, Zool. Jahrb. (Syst.), Band 83, Heft 5, 1955, p. 379.

Testudo emys Boulenger, Catalogue of the chelonians, rhynchocephalians, and crocodiles in the

British Museum, 1889, p. 158 *(part.)*; The fauna of British India, . . . Reptilia and Batrachia, 1890, p. 22 *(part.)*; Ann. Mus. Civ. Genova, 1893, ser. 2, vol. 13, p. 312.

Geoemyda latinuchalis Valliant, Bull. Soc. Philom. Parsi, 1894, ser. 8, vol. 6, p. 68 (type-locality, Rivière Noire, Tonkin); Mocquard, Rev. Colon. Rept. Indo-Chine, 1907, p. 10.

Testudo latinuchalis, Siebenrock, Zool. Jahrb., Suppl., 1909, vol. 10, p. 520; Boulenger, A vertebrate fauna of the Malay Peninsula. . . . Reptilia and Batrachia, 1912, pp. 15-16.

Testudo pseudemys Boulenger, Fasciculi Malayenses, Zoology, 1903, vol. 1, p. 144, pl. 9, text fig. 1, skull (type-locality, Batang Padang district, Perak); Annandale, Jour. Proc. Asiat. Soc. Bengal, 1906, ser. 2, vol. 2, p. 204.

Diagnosis: Land tortoise reaching a carapace length of 270 mm. Carapace much flattened on dorsal surface, vertebral and costal scutes somewhat concave, the marginals somewhat recurved laterally and posteriorly; vertebrals as wide or nearly as wide as costals; upper and lower part of arms covered with large imbricating scales, those on front surface of arm spinelike, tips elevated; top of head with symmetrical shields.

Description of species (from a dried shell, No. 1647): Carapace strongly serrated all around its margin, dorsal surface strongly flattened, vertebral and costal plates somewhat concave; some marginals distinctly recurved or flaring; nuchal scute distinctly wider than long (22 x 12 mm), anterior part with two spinelike denticulations distinctly shorter than adjoining marginals (28.5 mm); measurements of vertebrals, width x length in mm: first, 43 x 35, sides parallel for much of its length; second, 55 x 27.5; third, 56 x 28, ends parallel; fourth, 52 x 34; fifth, 47x 34. Measurements of costals, length x width in mm: first, 37 x 48; second, 36 x 54; third, 37 x 52; fourth, 35 x 35; subcaudals divided with a A-shaped notch.

Plastron wide, with a distinct bridge, broadly notched anteriorly and posteriorly, shorter than carapace; gulars with small spinelike processes; pectorals with a notch near axillary scute; inguinal and axillary scutes well developed, former divided in two on one side; length of median sutures in mm: gular, 15; humeral, 36; pectoral, 10; abdominal, 52; femoral or inguinal, 24; anal, 17. Length of bridge considerably longer than posterior lobe; areolar area of abdominals slightly elevated. Lines of growth on plastron and carapace strongly marked and alveolar areas of carapace clearly corrugated, borders of the scutes sharply angular. Posteriorly plastron and carapace almost touch.

Arms somewhat flattened, fingers scarcely separated, without web; front face of upper and entire lower arm with heavy, enlarged, bony, imbricating scutes, some sharply pointed and with points elevated; leg similarly scaled, largest scales spinelike; scales on heel; foot hooflike, sole covered with large, slightly imbricating scales; tail short with paired scales below, upper part covered with irregular scales; a very large conical scute on thigh, 12 mm high.

Head moderately large, top with more or less symmetrical shields consisting of a frontal preceded by 2 pairs of shields; upper jaw not or but slightly hooked. Some small dark spotted scales back of jaws.

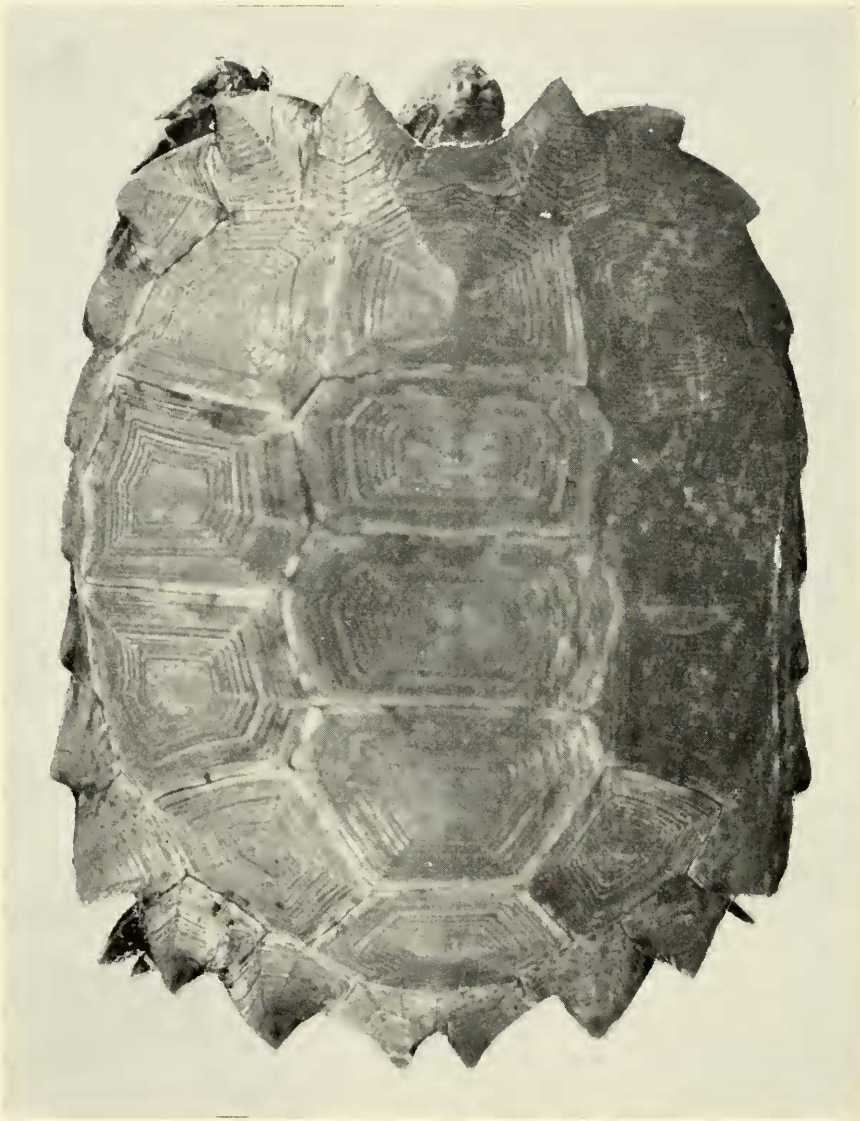

FIGURE 8. *Testudo impressa* (Günther). Chulalongkorn Univ. No. 1647, Carapace length, 166 mm; carapace width, 140 mm.

Color: Light brown of varying shades, lighter near sutures; about periphery of each scale, short dark brown radiating lines. Laterally on marginals some indefinite larger dark spots; plastron yellow-brown becoming pale yellowish near sutures; distal remnants of radiating lines.

Arms nearly black; legs and tail very dark brown.

Measurements in mm: Length of carapace, 166; width of carapace, 140; depth of shell, 73; length of plastron, 161; width of plastron, and bridge (pectorals), 123; width of anterior lobe, 96; width of posterior lobe, 91; length of posterior lobe, 56; length of bridge, 68.

Variation: The described specimen is considerably more than half grown as the species reaches a length of at least 270 mm in carapace length.

Young specimens may be light yellowish brown above, finely speckled with black. Some specimens have strongly defined dark rays on the plastron.

Distribution: In Thailand the species has been taken in relatively few places. It is a mountain species found at moderate altitude. The type was taken in Thailand but the exact locality is unknown.

Malcolm Smith (1916c) reports a series of specimens taken in Thailand but does not give exact localities. It is not a common species. The specimen here described has no specific locality recorded.

Remarks: The sculpturing of the carapace, the strongly serrate character of the marginals, and the rich brown coloration of the carapace combine to make this perhaps the handsomest of the turtles and tortoises of Thailand.

Several excellent figures of this species are given by Dr. Boonsong Lekagul (1966, p. 59).

Superfamily **Chelonioidea**

Head partially retractile, forming an S-shaped curve in a vertical plane; cervical vertebrae short; outer part of the tympanic cavity not roofed over by bone.

Pterygoid bones forming a median suture anteriorly, posteriorly rather widely separated; squamosals and parietals forming a suture. A complete set of marginal bones joined to the ribs. Pelvic girdle not fused to carapace or plastron. Carapace bones covered with horny epidermal shields.

One family, the Cheloniidae, is associated with this superfamily.

Family **Cheloniidae** Gray

Nuchal plate lacking a riblike process. Nine plastral bones. Temporal region of skull roofed over completely. Plastral elements reduced in size with a median vacuity between the 2 lateral halves, and connected to carapace by ligamentous tissues. Costal plates above ribs covering most of dorsal area in one form *(Chelonia),* leaving wide fontanelles between them and marginal bones. In *Eretmochelys* they may reach the marginals in old age. In others the fontanelles may disappear in adult.

The family Cheloniidae Gray consists of four recognized genera each comprising a single species: *Caretta* Rafinesque, *Chelonia* Latreille, *Eretmochelys* Fitzinger and *Lepidochelys* Fitzinger. These may be separated by the following key:

KEY TO GENERA OF THE CHELONIIDAE

1. Five or more pairs of costal shields 3
   Four pairs of costal shields 2
2. Two pairs of prefrontal shields; dorsal scutes on carapace imbricate, tending to become juxtaposed in very old specimens; jaws hooked ..... *Eretmochelys*
   One pair of prefrontal shields on head; dorsal scutes on carapace always juxtaposed; jaws not hooked ..... *Chelonia*
3. Normally 6 pairs of costals; interegular shield usually present (sometimes divided); usually 27 marginals; carapace reaches a length of 1050 mm ..... *Lepidochelys*
   Normally 5 pairs of costals. Three relatively large inframarginal scutes. Last few neural plates may be separated by costal plates which meet on midline. Color usually dull reddish brown; 2 pairs of prefrontals, marginals usually less than 27 ..... *Caretta*

Genus **Eretmochelys** Fitzinger

Eretmochelys Fitzinger, Systema Reptilium, 1843, p. 30 (type of genus, *imbricata*).

Diagnosis: Four pairs of costal shields; an intergular shield; a series of inframarginal shields between carapace and plastron; 3 or 4 axillaries and 1 or 2 inguinal shields; regular plastral scales keeled, anals with highest keels. Head covered with regular shields consisting of a frontal preceded by 2 pairs of scales, a pair of supraorbitals, parietals, occipitals, 2 large supratemporals, and 8 or 9 temporals; arms flipperlike; legs similar, shorter, widened; carapace covered with strongly imbricating shields, all keeled with accessory nonparallel ridges; a nuchal, 5 ventral, 4 costal, and 24 marginal shields; jaw hooked; a large shield following the shield on lower jaw; usually 2 claws on hand and foot.

Only a single species with two subspecies is recognized. These may be distinguished by the following key:

KEY TO SUBSPECIES OF *Eretmochelys imbricata*

1. Carapace somewhat straight-sided and narrowly tapered behind; upper surface of head and flippers with less black coloration. Atlantic Ocean, Caribbean Sea ..... *imbricata imbricata*
   Carapace usually somewhat heart-shaped in lateral outline, upper surface of head and flippers almost solid black. Indian and Pacific Oceans ..... *imbricata bissa*

Eretmochelys imbricata bissa (Rüppell)

(Figs. 9-10)

Caretta bissa Rüppell, Neue Wirbelthiere zu der Fauna von Abyssinien gehörig, 1835, p. 4 (type-locality, Red Sea).

Eretmochelys squamata Agassiz, Contribution to the natural history of the United States of

America, vol. 1, 1857, p. 382 (type-locality, restricted to Singapore); M. Smith, The fauna of British India. . . . Reptilia and Amphibia, vol. 1, Loricata, Testudines, Mar. 1931, pp. 67-69, fig. 12.

Chelone imbricata Boulenger, Catalogue of chelonians, rhynchocephalians, and crocodiles in the British Museum, 1889, p. 183; The fauna of British India, including Ceylon and Burma, Reptilia and Batrachia, 1890, p. 49.

Chelonia imbricata Siebenrock, Zool. Jahrb. Jena (Suppl.) 10, Heft 3, 1909, p. 547 *(part.)*.

Caretta squamata, Günther, The reptiles of British India, 1864, p. 54.

Eretmochelys imbricata, Taylor, Amphibians and Turtles of the Philippine Islands, 1921, pp. 180-182, pl. 15, figs. 1, 2; pl. 16, figs. 5, 6.

Caretta rostrata Girard, U.S. Exploring Expedition, Herpetology, 1858, p. 442, pl. 30 (type-locality, Fiji Islands).

Eretmochelys imbricata bissa, Smith and Taylor, Bull. U.S. Nat. Mus. Washington, no. 199, 1950, p. 16; Mertens und Wermuth, Die rezenten Schildkröten. . . . Zool. Jahrb. (Syst.), Band 83, Heft 5, 1955, p. 385.

Diagnosis: Characters of genus.

Description of species (from No. 1652, Gulf of Siam): Carapace low, covered with strongly imbricating shields; a well-defined sharp median keel; lateral keels dim, indistinct; nuchal wide, nearly double width of adjoining marginals; more than twice as wide as long (from nuchal edge); all vertebrals distinctly wider than long (from overlapping edge of preceding scale); first 3 costals distinctly larger than vertebrals; all costals wider than long. Vertebrals and to lesser extent costals with 2 accessory keels lateral to median, which tend to converge posteriorly on each scale; carapace serrate, lateral and posterior marginals terminating in a sharp, rather spinelike projection; supracaudals with a slight posterior notch.

Carapace rather flattened on a level with border of carapace; a triangular median intergular; measurements in mm of the plastral sutures are: gulars, 21; humerals, 30; pectorals, 32; abdominals, 37; femorals, 37; anals, 46. Plastral shields with continuous keels converging somewhat at each end of carapace, highest posteriorly; a row of 4 flat intercalated shields between plastron and carapace, all a little longer than wide; 5 smaller axillary shields and 2 small inguinal scales, the latter separated.

Arms paddle-shaped, with 2 claws evident on distal anterior edge of paddle; front face of paddle covered with enlarged scutes arranged in several irregular rows; underside (posterior) face with similarly enlarged scutes more irregularly arranged; front face of leg and foot with irregular rows of scutes; posterior face with numerous enlarged, as well as small scutes.

Tail very short, dorsal part with 2 or 3 paired scales; a specialized shield follows postanals.

Head covered with shields (or scutes), consisting of a large shield covering most of upper jaw and beak, small soft plate through which both nostrils are pierced, a pair of supranasals, a larger pair of prefrontals preceding a single frontal flanked by large supraorbitals, a pair of fused parietals, and a pair of occipitals. Eight temporals follow supraorbital; an elongate scute follows the large scute on lower jaw.

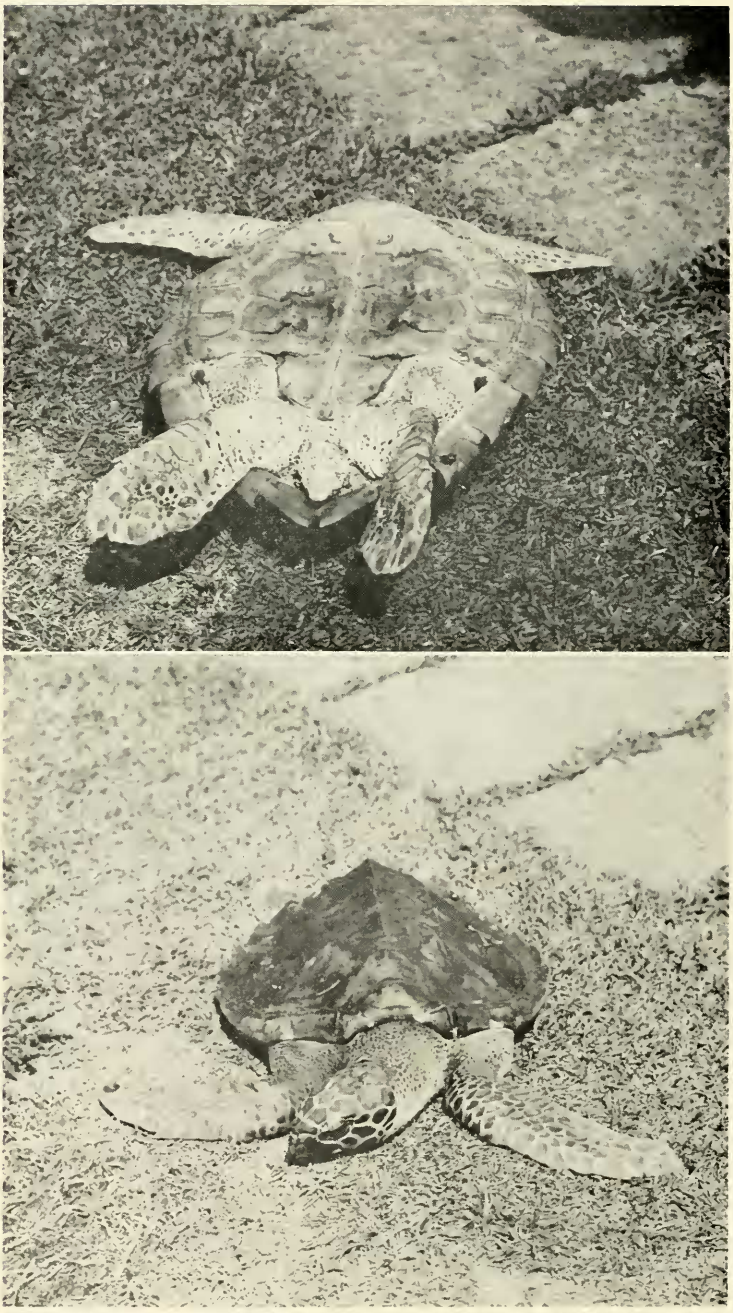

FIGURE 9. *Eretmochelys imbricata bissa* (Rüppell). Philippine Bureau of Science No. 1474. Carapace length, 173 mm. Upper figure, ventral view; lower, dorsal view.

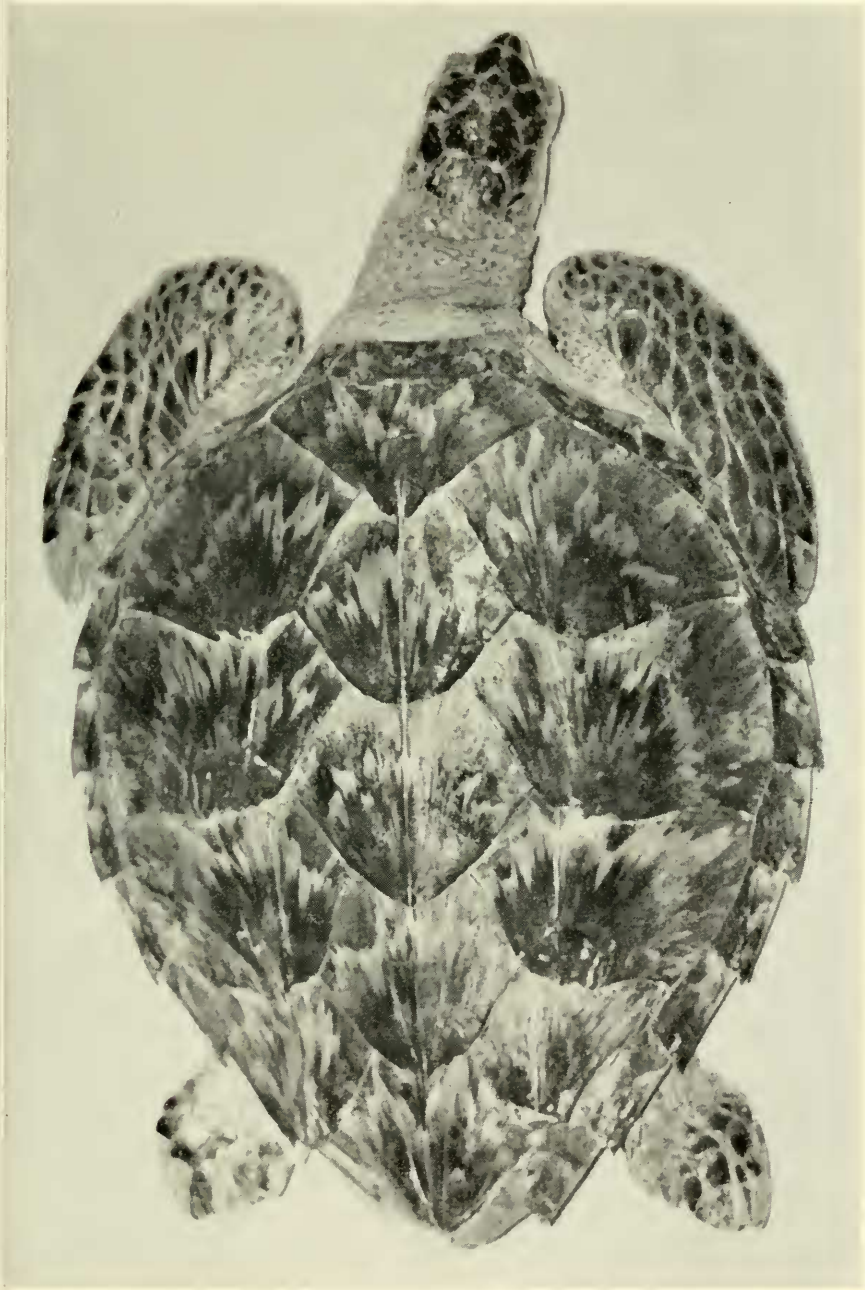

FIGURE 10. *Eretmochelys imbricata bissa* (Rüppell). Philippine Bureau of Science No. 1474 (young). Aparri, Luzon. Carapace length, 245 mm.

Color: Above brown, streaked with amber; plastron light yellowish, darker along posterior part of keels; scales of head, arms, and legs brown, often with yellowish borders.

Measurements in mm: Total length, 244; length of carapace, 173; width of carapace, 130; length of plastron, 134; width of plastron across pectorals, 81; length of arm, 98; length of leg, 53; head length, 47; head width, 30 (from Taylor [1921], Philippine specimen, No. 1474 Bureau of Science Coll.; Manila).

Variation: The dorsal shields, normally imbricate, may become practically juxtaposed in very old animals.

Distribution: In Thai waters the species occurs around the entire coast-line but nowhere is it regarded as common as other species of marine turtles.

It is widely distributed along tropical and subtropical coast-lines of the Pacific and Indian Oceans.

Remarks: This species furnishes the "turtle shell" of commerce. It is still collected, but now has to compete with artificial "tortoise shell."

Genus **Chelonia** Brongniart

Chelonia Brongniart, Bull. Sci. Soc. Philom., vol. 2, 1800, p. 89 (type of genus, *Chelonia mydas*).

Diagnosis: Five vertebrals, 4 pairs of costal shields. An intergular scale separating anterior part of gulars. A series of inframarginal scales (4 or 5). Eleven pairs of marginals and 1 pair of supracaudals. Head with regular symmetrical scales. One pair of prefrontals; nuchal transversely widened. Jaws not hooked.

A single species is recognized with at least two subspecies. They occur in the Atlantic, Pacific, and Indian Oceans.

Chelonia mydas Linnaeus

Testudo mydas Linnaeus, Systema Naturae, ed. 10, vol. 1, p. 197 (type-locality [restricted by Mertens and Müller, 1928], Asuncion Island).

Chelonia mydas japonica (Thunberg)

(Fig. 11)

Testudo japonica Thunberg, Kongl. Vetensk. Acad. Handl., Stockholm, 1787, vol. 8, p. 178 (type-locality, Japan).

Caretta thunbergii, Merrem, Tentamen Systematis Amphibiorum, 1820 (substitute name for *T. japonica* Thunberg).

Chelonia mydas japonica, Gray, Synopsis Reptilium or short descriptions of the species of reptiles, pt. 1, Cataphracta, tortoises, crocodiles and enaliosaurians, pt. 1, p. 53; Mertens und Wermuth, Zool. Jahrb. (Syst.), Band 83, Heft 5, 1955, pp. 384, 385.

Chelonia formosa Girard, U.S. Exploring Expedition, Herpetology, 1858, p. 456 (type-locality, Fiji Islands).

Chelonia tenuis Girard, U.S. Exploring Expedition, Herpetology, 1858, p. 459 (type-locality, "Tahiti, Honden, Eimeo and Rosa Islands").

Chelonia agassizii Bocourt, Ann. Sci. Nat., Paris, ser. 5, vol. 10, 1868, p. 122 (type-locality, mouth of Río Nagualate, Pacific Coast of Guatemala).

Chelonia lata Philippi, Zool. Garten, Frankfurt am Main, 1887, vol. 28, p. 84 (type-locality, Valparaiso, Chile).

Chelonia japonica Taylor, Amphibians and Turtles of the Philippine Islands, Manila, Pub. 15, Bureau of Science, 1921, pp. 184-185, pl. 17, figs. 1-4.

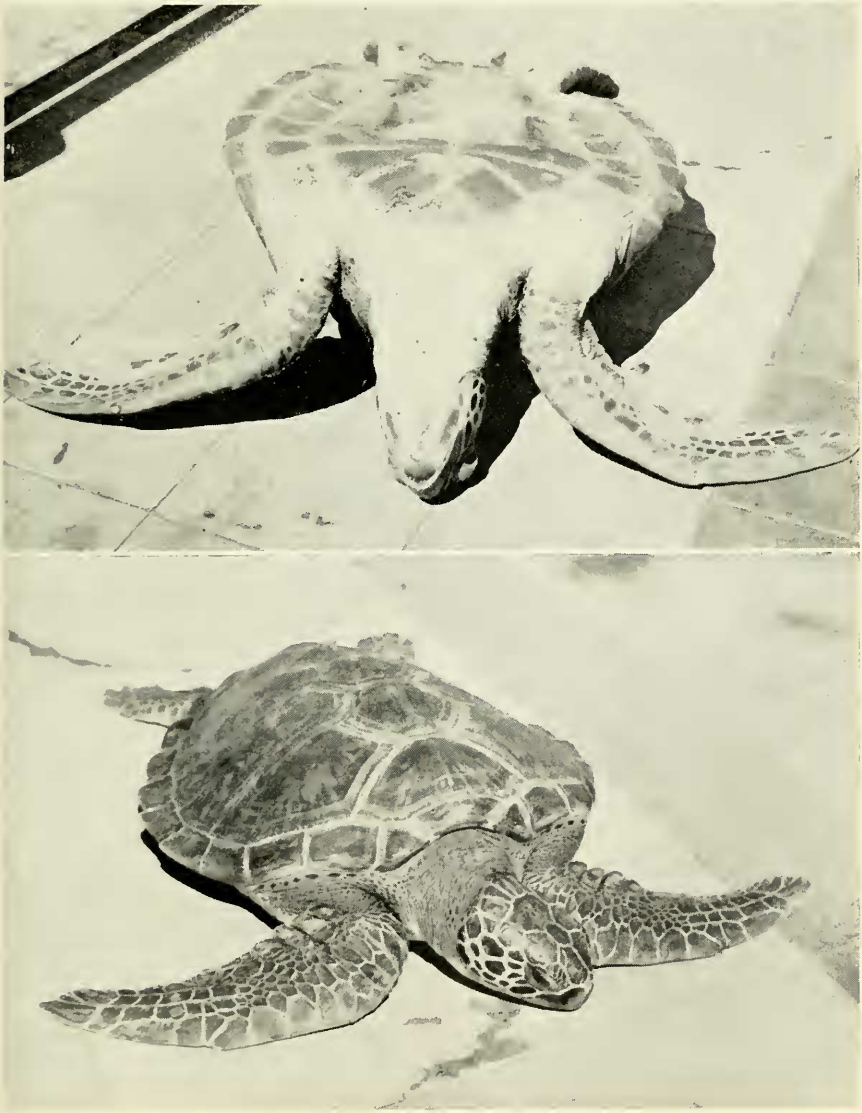

FIGURE 11. *Chelonia mydas japonica* Thunberg. Specimen living in the Manila Aquarium. Manila Bay, near Manila. Carapace length, 735 mm. (Also figured in Taylor, 1920.) Upper, ventral; lower, dorsal view.

Diagnosis: Limbs paddle-shaped, with 1 or 2 claws. Shell covered with horny shields; costal plates fused to ribs and carapace, not extending to edge of carapace. Having other characters of the genus.

Description of species: Large marine form commonly known as the Green Turtle. Carapace longer than wide, somewhat arched, slightly serrate posteriorly; 11 pairs of marginals, a broad nuchal and paired supracaudals border rim of carapace; 5 vertebrals wider than long; 4 pairs of costals. Plastron separated from marginals by a series of 4-5 inframarginals; 6 pairs of plastral shields with a single intergular preceding the gular pair.

Head rather large, the snout short; edges of the jaws denticulated, much more strongly so on the lower jaw; upper alveolar surface of upper jaw with 2 strongly denticulated ridges; lower jaw with a short symphysis. One pair of prefrontal shields. Limbs paddle-shaped usually with only a single claw present.

The young specimens usually with a median keel, sometimes with a lateral keel also. Young may have 2 claws. Their color olive to dark brown with some yellow markings on limbs; venter yellowish, with dark areas on hands and feet. The adults are likewise greenish to grayish brown. Some specimens show dark rays. Plastron yellow.

The length of the shell often exceeds a meter.

Measurements in mm: Total length, 735 (head to tail); length of carapace, 555; width of carapace, 470; height of shell, 180; length of plastron, 448; width of plastron across pectorals, 125; width of head, 90; depth of head, 100; tail, from vent, 28.

Remarks: Despite the paddle-shaped limbs the original bony system of limbs and girdle is present with only a few exceptions. The fontanelles between the marginals and costals are never completely covered by bone in this genus.

This species is widely eaten. Sir J. E. Tennant (1861), former civil secretary to the colonial government of Ceylon, reports a case of a turtle of this species being eaten in Ceylon causing the death of 18 persons. This was October 1840.

Taylor (1922) reports a similar case from Cebu Island where a turtle was consumed by 33 persons, 14 of whom died. It is not known whether the meat becomes poisonous only at certain seasons, or age, or whether it is due to some type of poisonous plant consumed by the turtle or by some disease. It is not impossible that the meat had been allowed to spoil before being consumed but there was no evidence that this was true in the latter case.

Genus **Lepidochelys** Fitzinger

Lepidochelys Fitzinger, Systema Reptilium, 1843, p. 30 (type of genus, *Lepidochelys olivaceus* (Eschscholtz)); Carr, Proc. New England Zool. Club, vol. 21, 1942, p. 4.
Chelonia Eschscholtz, Zool. Atlas, 1, 1829, p. 3.

Diagnosis: "Maxillaries not in contact, separated by vomer; frontal bone entering rim of orbit; pterygoids markedly broadened anteriorly, the ectopterygoid process strong; fontanelles in choanal chamber near opening, not hidden by alveolar surface in ventral aspect; external opening of orbits not concealed by overlying bones in ventral aspect; descending processes of prefrontals not reaching palatines; lower jaw with a more or less sharp and strong triangular median element at the posterior border of the bony alveolar surface, which may or may not extend forward as an elevated ridge; four enlarged inframarginal scutes on the bridge; neural bones 11-15; color gray to olive green." (Carr, 1942.)

Lepidochelys olivacea (Eschscholtz)

Chelonia olivacea Eschscholtz, Zool. Atlas, 1, 1829, p. 3, pl. 3 (type-locality, Manila Bay, Philippines).

Three subspecies of *olivacea* are recognized by the Mertens-Wermuth List (1955). These are the typical *L. o. olivacea, L. o. kempi* (Garman) and *L. o. remivaga* (Hay). These 3 may be contrasted by the following brief diagnoses:

L. o. olivacea: Bony alveolar surface of each side of upper jaw usually with a gentle elevation extending parallel to the cutting edge but never with a conspicuous ridge; combined width of pterygoids behind expanded anterior portion usually contained no more than 2-2.5 times in greatest diameter of orbit; each inframarginal scute usually with a pore at its posterior border; costal scutes usually in more than 5 pairs; color olive. Indian and Pacific Oceans.

L. o. kempi: Bony alveolar surface of upper jaw with a median ridge extending parallel to the cutting edge; combined width of pterygoids, behind expanded anterior portion, contained about 3 times in greatest diameter of orbit; inframarginal scutes without pores; costal scutes usually in 5 pairs; color usually gray. Atlantic Ocean, Gulf of Mexico.

L. o. remivaga: Described by Hay (1908) from a skull from Ventosa Bay, Gulf of Tehuantepec, Mexico (without a carapace) chiefly by a comparison with that of *Caretta*. "The skull is flat, the snout more or less pointed. The frontal bones enter the rim of the orbit; maxillae are widely separated by the vomer. The pterygoids possess conspicuous ectopterygoid processes. The free border of pterygoid when followed backward becomes a ridge which disappears before it reaches the pedicel of the quadrate. Occipital condyle stands distinctly behind the quadrates. Prootic bones project but little in front of the pedicels. The frontal scute is about as long as the frontoparietal; the latter is not so long as the parietals. Known from Ventosa Bay, Gulf of Tehuantepec, Eastern Pacific Ocean."

Lepidochelys olivacea olivacea (Eschscholtz)

(Fig. 12)

Chelonia olivacea Eschscholtz, Zool. Atlas, 1829, vol. 1, pl. 3 (type-locality, Manila Bay, Philippines).

Caouana olivacea, Gray, Catalogue of the tortoises, crocodiles and amphisbaenians in the collection of the British Museum, 1844, p. 53; Günther, Reptiles of British India, p. 52.

Caretta olivacea, Garman, Bull. Mus. Comp. Zool. Harvard College, vol. 52, 1908, p. 9; Taylor, Amphibians and turtles of the Philippine Isands, Dept. Agri. Nat. Resources, Bureau of Science, Manila, No. 15, Dec. 15, 1921, pp. 182-184, pl. 17, figs. 1-4.

Thalassochelys olivacea, Boettger, Ber. Senck. Nat. Ges., 1886, p. 93.

Chelonia dussumierii Duméril and Bibron, Erpétologie Générale, vol. 2, 1835, p. 557.

Lepidochelys olivacea, Girard, U.S. Exploring Expedition, Herpetology, 1858, p. 435; Mertens and Wermuth, Zool. Jahrb. (Syst.), Band 83, Heft 5, 1955, p. 386.

Caretta caretta olivacea, M. Smith, The fauna of British India . . . including Ceylon and Burma. Reptilia and Amphibia, vol. 1, 1931, pp. 71, 72.

Diagnosis: Characters of the genus. Normally, 6 pairs of costals; intergular shield usually present, sometimes divided; usually 27 marginals. Carapace reaches a length of 1050 mm or more.

Description of species: Carapace with a distinct median keel, more prominent posteriorly; 6 pairs of costals, the nuchal divided; 6 vertebrals, the fifth small; 11 pairs of marginals with 2 supracaudals and 2 nuchals; a small inguinal shield, and a group of small axillary shields, 4 of which touch pectorals and humerals. A small round shield behind the anal shields.

The head scales on a Philippine specimen examined consisted of a pair of anterior prefrontals smaller than the second pair; an azygous prefrontal between 2 supraoculars; frontal large, wider than long, followed by 4 parietals; a large temporal (parietal) follows the supraocular and borders the frontal and parietal; 3 postoculars, upper smallest, middle largest, lower elongate; postoculars bordered by 4 temporals.

Color: Drab olive or gray-olive, somewhat lighter at sutures. Sides and underside of neck whitish. Plastron whitish with somewhat darker areas on plastral scutes.

Measurements in mm (Young living specimen): Length of carapace, 340; width of carapace, 325; height of carapace, 110; length of arm, 260; length of leg, 180; length of plastron, 275; width of plastron, 280; tail from vent, 15; length of head to end of parietals, 90; depth of head, 55.

Remarks: The subspecies is widely distributed in the Pacific and Indian Oceans. The young show indistinct dorsal and ventral keels.

Genus **Caretta** Rafinesque

Caretta Rafinesque, Specchio Sci. Palermo, vol. 2, 1814, p. 66 (type of genus, *Caretta nasuta* Rafinesque=*Testudo caretta* (Linnaeus)).

Diagnosis: "Five or more pairs of costal shields; intergular shield present or absent. A series of inframarginal plastral shields. Head covered with symmetrical shields; two pairs of prefrontals. Tail short." M. Smith (1931a).

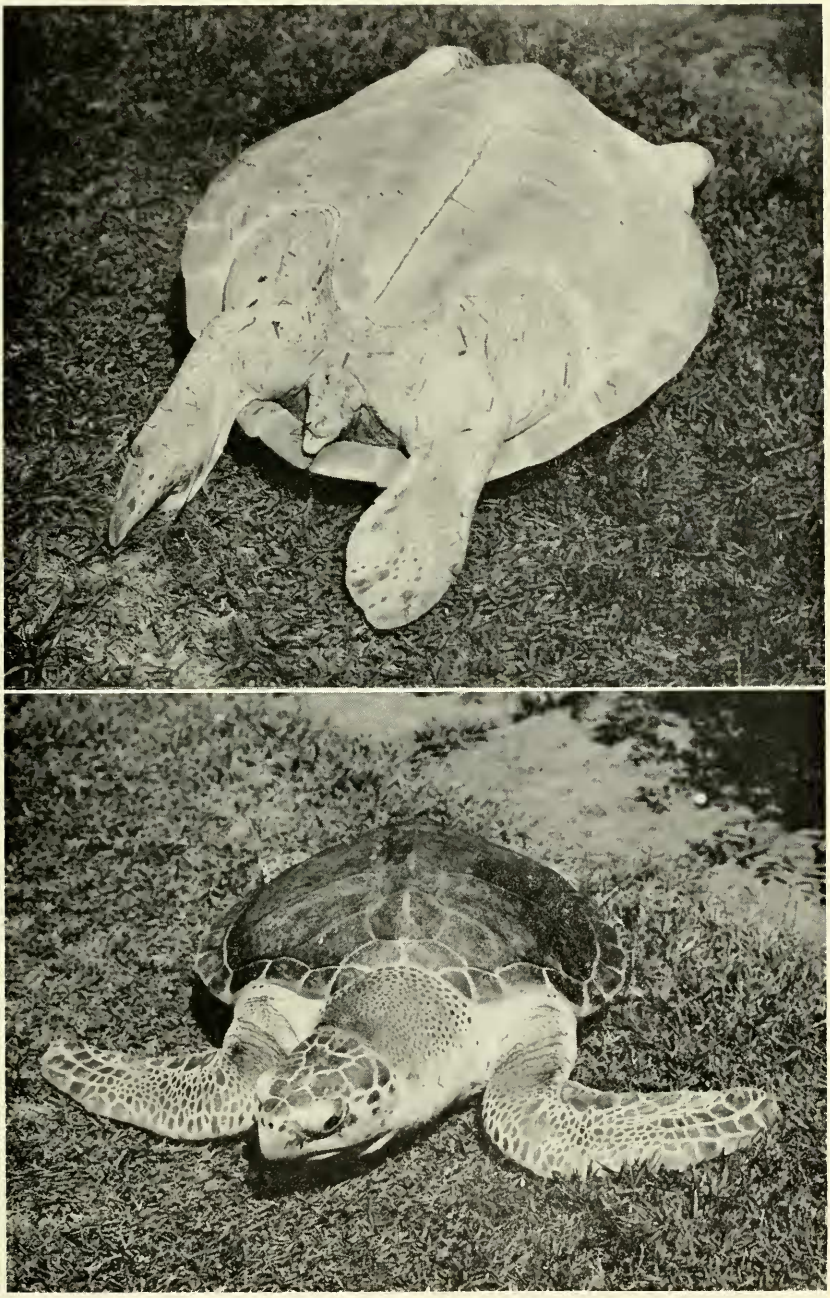

Figure 12. *Lepidochelys olivacea olivacea* (Eschscholtz). Specimen living in Manila Aquarium. Topotype, Manila Bay. Carapace length, 340 mm. Upper, ventral; lower, dorsal view.

There is considerable variation in the number of the shields that compose the carapace. The amount of variation is in part geographical as the greatest variation occurs in the Indian and Pacific Oceans.

Caretta caretta (Linnaeus)

Testudo caretta Linnaeus, Systema Naturae, ed. 10, 1758, vol. 1, p. 197 (type-locality restricted to Bermuda).

This species is regarded as comprising two subspecies, *Caretta c. caretta* Linnaeus and *C. c. gigas* Deraniyagala.

KEY TO SUBSPECIES OF *Caretta caretta*

1. Marginal scales on each side averaging 12; neural bones usually 7 or 8, rarely interrupted by costal plates (pleurals). Atlantic Ocean, Mediterranean Sea ..... *caretta caretta*

   Marginal scales usually 13 on each side; neural bones 7-12, the last bones of series (1-5) usually interrupted by costal plates (pleurals), which are in contact with each other. Indian and Pacific Oceans ..... *caretta gigas*

Caretta caretta gigas Deraniyagala

Caretta gigas Deraniyagala, Ceylon Jour. Sci., sec. B, vol. 18, 1933, p. 66 (type-locality, Gulf of Mannar, Ceylon).

Caretta caretta gigas, Deraniyagala, Tetrapod reptiles of Ceylon, vol. 1, 1939, p. 164.

Caretta caretta gigas, Mertens and Wermuth, Zool. Jahrb. (Syst.), Band 83, Heft 5, 1955, p. 383.

Caretta caretta olivacea, M. A. Smith, The fauna of British India, including Ceylon and Burma. Reptilia and Amphibia. vol. 1, Loricata, Testudines, Mar. 1931, pp. 71-72 *(part.)*.

Diagnosis: Differs usually but not invariably from the typical form in having 3 relatively large inframarginal scutes; usually 5 pairs of costals. The last few neurals interrupted by pairs of costals forming a median suture. The color, varying shades of reddish brown.

Description of subspecies: Characters of the genus.

Nuchal scute single; normally 5 costals. Marginals somewhat variable, 11-13 pairs. Plastron with paired gulars, pectorals, abdominals, femorals and anals, the lengths of sutures not differing greatly. Head with 2 pairs of prefrontals; frontoparietal large; 2 or 3 pairs of parietals; 2 supraoculars on each side; other postoculars and temporal scales somewhat variable.

Arms in the form of elongate paddles, each bearing 2 claws (rarely 1). Legs large but shorter than arms, the width and length nearly equal. Both arms and legs with scales and scutes of variable size, largest on inner edge of arm around posterior parts of each.

Carapace somewhat arched, longer than wide, and with posterior parts narrowed. Young with 3 keels above and 4 on the plastron below.

Remarks: Most of these data are from Deraniyagala, who gives a very detailed description of the typical form. The subspecies is widely distributed from Australia to Ceylon along the coast of southeast Asia and the islands of the Pacific Ocean.

I believe that this subspecies is exceeded in size only by *Dermochelys coriacea*.

Superfamily **Trionychoidea** Fitzinger

Head capable of being withdrawn completely within shell, neck forming a sigmoid curve in a vertical plane. Bones of carapace and plastron covered with soft skin instead of horny plates. Phalanges not free, encased in a paddlelike limb; arm with 2 or 3 claws. Pterygoids not forming a suture; basisphenoids forming sutures with palatines. Only a single Asiatic family, the Trionychidae, is associated with this superfamily.

Family **Trionychidae** Bell

Trionychidae Bell, Zool. Jour., vol. 3, 1828, p. 515.

Genus **Trionyx** Schweigger

Trionyx Schweigger, in Geoffroy Saint-Hilaire, Ann. Mus. Nat., Paris, vol. 14, 1809, p. 1 (type of genus *Testudo cartilaginea* Boddaert).

The differences between *Amyda* and *Trionyx* would seem to be not easily discerned. Both names appear in the same publication (Schweigger, *vide* supra), the type of *Trionyx* being *Trionyx coromandelicus* Geoffroy Saint-Hilaire (*Trionyx punctatus granosus* Schoepff). Various herpetologists have used the name *Trionyx* for this group of soft-shelled turtles; others have used *Amyda* which has page priority.

In certain recent publications authors have retained *Trionyx* for the greater number of the soft-shelled turtles of America, Africa and Asia. The group designated *Trionyx* by Geoffroy Saint-Hilaire were the "three toed" turtles with 7 plastral callosities. Malcolm Smith (1931a) regarded this group as equivalent to *Emyda* Rafinesque but shows that this name as used by Gray is a homonym of that of Rafinesque which was proposed as a substitute name for *Emys* Duméril. Smith then proposes a new name—*Lissemys*—for the group having 3 toes and 7 plastral callosities and a "cutaneous femoral valve" with marginal bones.

Diagnosis: Thus *Trionyx* may be defined as lacking a cutaneous valve, marginal bones, and as having 4 plastral callosities. Orbit nearer to temporal cavity than to nasal cavity; arch following orbit narrower than orbital diameter; proboscis as long as eye opening. The dorsal surface of the young bears longitudinal series of small tubercles.

Trionyx cartilaginea (Boddaert)

Testudo cartilaginea Boddaert, Epistola ad W. Roell, cum tab. 1770, pp. 1-39 (type-locality unknown).

Trionyx cartilagineus, Boulenger, Catalogue of the chelonians, rhynchocephalians, and crocodiles in the British Museum, 1889, p. 253, fig.; The fauna of British India. . . . Reptilia and Batrachia. 1890, p. 15; Siebenrock, Sitzungsb. Akad. Wiss. Wien, vol. 112, pt. 1, 1903, p. 347; Zool. Jahrb. Jena, Suppl. 10. Heft 3, 1909, p. 599; de Rooij, The reptiles of the Indo-Australian Archipelago, vol. 1, Lacertilia, Chelonia, Emydosauria, 1915, pp. 329-330, fig. 127; Annandale, Rec. Ind. Mus., vol. 7, pt. 2, 1912, p. 168; M. Smith, The fauna of British India, . . . including Ceylon and Burma. Reptilia and Amphibia. vol. 1, Loricata and Testudines, Mar. 1931, pp. 174-175, figs. 31-33.

Testudo rostrata Thunberg, Kongl. Vet.-Akad. N. Handl., Stockholm, vol. 8, 1787, p. 179, pl. 7 (type-locality, India).

Trionyx stellatus Geoffroy-Saint Hilaire, Ann. Mus. Nat. Hist. Paris, vol. 15, 1809, p. 13 (type-locality?); Theobald, Proc. Asiat. Soc. Bengal, 1874, p. 79, pl. 3; *ibid.,* 1875, p. 176, pl. 5.

Trionyx Javanicus Geoffroy Saint-Hilaire, Ann. Mus. Nat. Hist., Paris, vol. 15, 1809, p. 15, pl. 3 (type-locality, Java).

Trionyx cariniferus Gray, Catalogue of the shield reptiles in the collection of the British Museum, part 1, Testudinata (Tortoises), 1855, p. 67, pl. 32 (type-locality, Moluccas); Theobald, Proc. Asiat. Soc. Bengal, 1874, p. 80, pl. 4.

Trionyx ornatus Gray, Proc. Zool. Soc. London, 1861, p. 41, pl. 5 (type-locality, Cambodia).

Aspilus punctulatus Gray, Proc. Zool. Soc. London, 1864, p. 84 (type-locality, Amboyna or Ceram).

Trionyx jeudi Gray, Proc. Zool. Soc. London, 1869, p. 217, fig. (type-locality, ? Dutch East Indies).

Trionyx ephippium Theobald, Proc. Asiat. Soc. Bengal, 1875, p. 177, pl. 5 (type-locality, Tenasserim).

Amyda cartilaginea, Barbour, Mem. Mus. Comp. Zool. Harvard Coll., vol. 44, 1912, p. 144; Mertens and Wermuth, Zool. Jahrb. (Syst.), 1955, Band 83, Heft 5, p. 387.

Trionyx phayrei Theobald, Jour. Linn. Soc., London (Zool.), vol. 10, 1870, p. 18 (type-locality, Mts. of Arakan, Bassein District, West Pegu, Burma); Boulenger, Catalogue of the chelonians, rhynchocephalians, and crocodiles in the collections of the British Museum, 1889, p. 251.

Diagnosis: A single neural plate between anterior pair of costals; lower jaw with a longitudinal symphysial ridge; epiplastra sutured or closely approximated. Plastral callosities never more than 5 and depending on environmental factors may be poorly developed even in adults. Portion of skull preceding orbits longer than orbital diameter, especially so in young specimens; postorbital arch usually one half or less than orbital diameter.

The synonymy here offered may well be divisible into recognizable subspecies but series of specimens of the presumed forms are usually lacking from areas where the variants are known. Then, too, differences in external characters (*i.e.* plastral callosities) may in a measure depend on the characters of stream beds where the animal lives, so that even series of specimens may not solve the problem completely.

Description of species: Costal plates well developed, the last pair in contact on midline. All plates of carapace strongly pitted and vermiculate. Four plastral callosities, the hyo-hypoplastral and xiphiplastral; all may be poorly developed in adult specimens. Anterior processes of epiplastra long and

slender. Epiplastra usually in contact; postorbital arch about one half of the orbital diameter, sometimes only one third of the diameter.

General coloration of young grayish to greenish, often dotted or spotted with yellow and yellow-edged black spots; dull white below. Head with yellow spotting especially on ventrolateral region; small spots on limbs.

The dark spots, usual in the young, tend to disappear completely in adult, leaving the surface a unicolored greenish gray. Spots may become indistinct on head but the intervening spaces darken, tending to form a dark network on an olive surface. Underside of head and neck, much lighter. (Description from literature.)

Remarks: The species becomes large, specimens with a carapace length greater than 700 mm being known. It is variable and certain of the variants have been named. Some of the specimens have a hyoid body copulae consisting of 3 pairs of bones, while in some there are 4 pairs. There are 2 large bony pairs of cornua attached to the 2 last members of the copulae. Certain of the specimens tend to show a slightly hump-backed condition.

Their food is chiefly of fish, crustaceans and amphibia.

These turtles are often kept in tanks of water in various shops in Bangkok where they are available for purchase. Usually younger or perhaps half-grown individuals are most frequently available. They are very vicious and one must handle them with considerable care to avoid being severely bitten, since their necks are much longer than one would suppose.

Genus **Pelochelys** Gray

Pelochelys Gray, Proc. Zool. Soc. London, 1864, p. 89 (type of genus, *Pelochelys cantorii* =*Trionyx (Gymnopus) bibroni* Owen).

Diagnosis: There are 7 neural plates. The outer part of nuchal plate overlies second dorsal rib; 8 pairs of costal plates, the last two touching mesially. Skull broad, not especially lengthened, flattened above. The postorbital arch broader than orbital diameter. Posterior border of pterygoid unattached. Hyoplastron distinct from hypoplastron. Tail very short.

Only a single species is referable to this genus. It ranges widely from Burma, throughout southern China, Indo-China, Thailand, Malaya, Sumatra, Java, Borneo, New Guinea and the Philippines. It would seem certain that this present distribution is in part due to its introduction by man since the species is widely used as food, and often carried from place to place.

Pelochelys bibroni (Owen)

(Fig. 13)

Trionyx (Gymnopus) bibroni Owen, Catalogue of the Osteological Series in the College of Surgeons, 1853, p. 185 (type-locality "Australia") (probably erroneous); M. A. Smith, Bull. Raffles Mus. Singapore, No. 3, 1930, p. 3.

Pelochelys cantorii Gray, Proc. Zool. Soc. London, 1864, p. 90 (type-locality, Malacca, Malaya); Theobald, Jour. Linn. Soc., 1868, p. 10.

Pelochelys cumingii Gray, Proc. Zool. Soc. London, 1864, p. 90 (type-locality, Philippines); Catalogue of the shield reptiles, Supplement, 1870, p. 91.

Pelochelys cantoris, Boulenger, Catalogue of the chelonians, rhynchocephalians, and crocodiles in the British Museum, 1889, p. 263; Fauna of British India, including Ceylon and Burma, 1890, p. 15; Casto de Elera, Catalogue of the Fauna of the Philippines, 1, 1895, p. 406; Flower, Proc. Zool. Soc. London, 1899, p. 621; Werner, Zool. Jahrb., Band 13, 1900, p. 483; Siebenrock, Sitz-ber. Wiss. Wien, Band 111, 1902, p. 832, fig. 12; Band 112, 1903, p. 350; Zool. Jahrb., Suppl. 10, Heft 3, 1909, p. 607; de Rooij, Reptiles of the Indo-Australian Archipelago, vol. 1, 1915, p. 331 *(cantori).*

Pelochelys poljakovii Strauch, Mem. Acad. Sci. St. Petersburg (7), vol. 38, 1890, 2, p. 118 (type-locality—"Fu Tschau," China).

Pelochelys bibroni, M. A. Smith, Bull. Raffles Mus., 1930, no. 3, p. 3; The fauna of British India, including Ceylon and Burma. Reptilia and Amphibia. vol. 1, Loricata, Testudines, 1931, pp. 160-162; Mertens and Wermuth, Zool. Jahrb. (Syst.), Band 83, Heft 5, 1955, p. 394.

Diagnosis: Characters of the genus.

Description of species (from a captive specimen): One of the large members of the family reaching a length above 650 mm. Orbits back from front of snout by a distance greater than their diameter. One neural plate between first pair of costals. Plates strongly sculptured with pits and depressions. The anterior parts of epiplastra short and broad, widely separated from each other; 4 well developed hyoplastral and xiphiplastral callosities in adult. Head relatively small, broad, its length about 1.75 times as long as wide. Snout short, proboscis forming only a slight projection. Carapace moderately flat, composed of a bony inner part surrounded by a wide cartilaginous border. The soft parts of carapace posteriorly crisscrossed with lines at nearly right angles to each other; laterally lines do not cross. A depressed area mesially running lengthwise of carapace.

Three inner digits of arms and legs with long strong claws, that of inner toe largest. The two outer toes not extending beyond edge of strong web or fringe which extends along leg. A small callosity at base of inner toe. A strong scalelike callosity across outer part of arm; 3 callosities in web on outer side of arm. One large elongate callosity on posterior side of leg and a heavy widened scalelike callosity on heel.

Head large, much widened in temporal region. Proboscis short, tips thick; eyes small with a dark line both in front and behind pupil. Tail short behind vent.

Color in life: Head above olive with minute black dots; carapace olive, with a few darker and lighter striations along median dorsal part; outer edge olive with small spots of darker and lighter color. Plastron flesh-colored with a few white dots on anterior parts. Chin and throat with minute dots of black and white.

Measurements in mm: Length, 350; width, 315; height of carapace, 76; length of plastron, 295; width of plastron, 290; total length, head extended, 630.

Remarks: The live captive specimen here described did well in captivity.

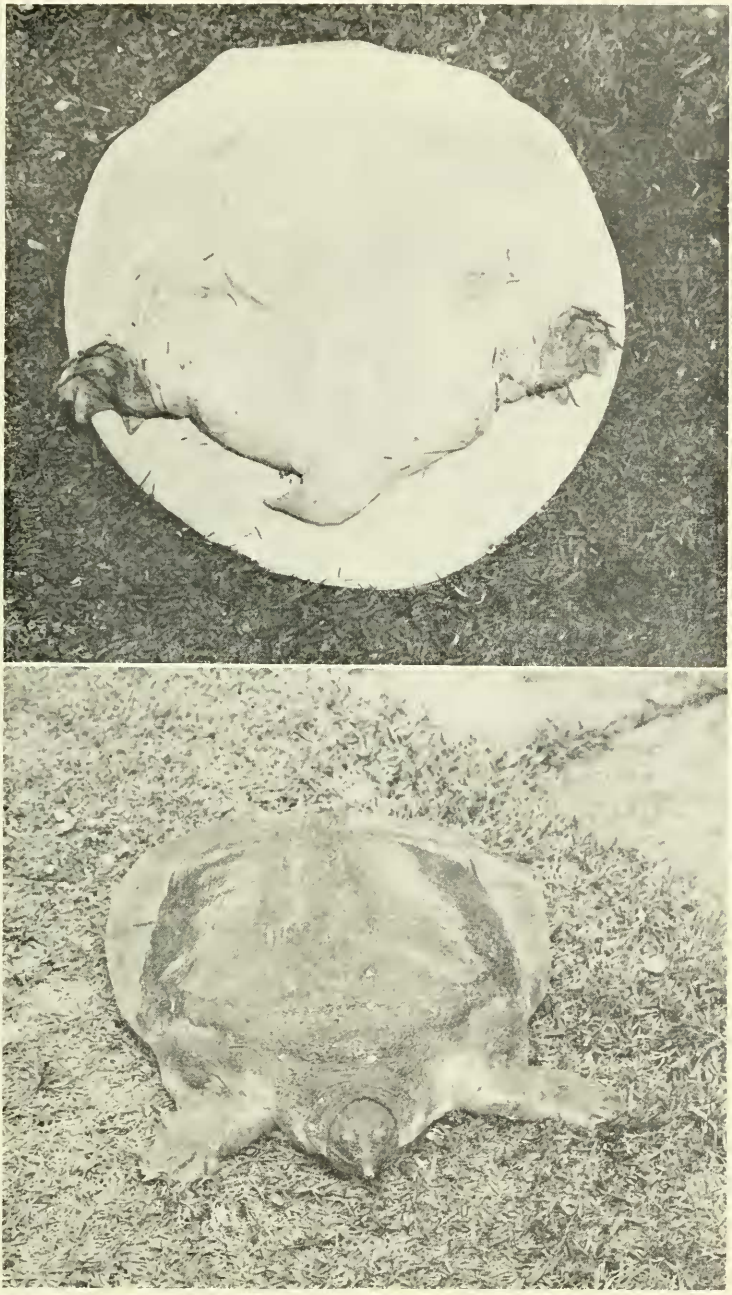

Figure 13. *Pelochelys bibroni* (Owen). Specimen living in Manila Aquarium, from San Miguel, Bulacan Prov., Luzon, P.I. Carapace length, 350 mm. Upper, ventral; lower, dorsal view.

It was kept in a tank containing two fish species *Cyprinus carpio* and *Megalops cyprinoides.* These fish were not molested. If *Ophiocephalus striatus,* the mud fish, was introduced, this was killed.

Malcolm Smith (1931a) reports 4 specimens from Central Thailand. I have examined 2 living specimens of unknown provenance in Bangkok. They were presumed to have been captured in the Chao Phraya river, in Bangkok.

Smith (1931a) calls attention to Günther's figure (1864b) stating that it represents a *Pelochelys bibroni* but with the markings of *Chitra indica!*

Genus **Chitra** Gray

Chitra Gray, Catalogue of the tortoises, crocodilians and Amphisbaenians in the collection of the British Museum, 1844, p. 49 (type of genus, *Trionyx indicus* Gray).

Diagnosis: Orbits very close to each other (the distance between them about half their diameters). Skull narrow, its length twice its width. The outer part of nuchal plate overlies second dorsal rib; 8 neural plates forming a continuous series; 8 costal scales on each side, the last pair medially in contact. Hyoplastron and hypoplastron distinct from each other. A post-orbital arch about double the diameter of orbit; posterior border of pterygoid free, without an ascending process. Tail short.

Only a single species is known in the genus.

Chitra indica Gray

Trionyx indica Gray, Synopsis Reptilium or short descriptions of reptiles, Part 1, Cataphracta, tortoises, crocodiles, and enaliosaurians, 1831, p. 47 (type-locality, Fatehgarh, Ganges "Northern India").

Trionyx aegyptiacus var. *indica,* Gray, Illustrations of Indian Zoology, vol. 1, pl. 80, 1831 (type-locality—Fatehgarh, Ganges, India); Catalogue of the shield reptiles in the collection of the British Museum, Pt. I, Testudinata (tortoises), 1855, p. 41.

Chitra indica, Gray *(part.),* Catalogue of the tortoises, crocodiles and amphisbaenians in the collection of the British Museum, 1844, p. 49; Günther, Reptiles of British India, 1864, p. 50, pl. 5 *(part.);* Boulenger, Catalogue of the chelonians in the British Museum, 1889, p. 264, fig. 70; Fauna of British India, 1890, p. 16; Annandale, Rec. Ind. Mus., vol. 7, 1912, p. 169, pls. 6 and 11; M. A. Smith, Jour. Fed. Malay States Museum, vol. 10, 1922, p. 264; The Fauna of British India including Ceylon and Burma. Reptilia and Amphibia, vol. 1, Loricata, Testudines, 1931, pp. 162-164, fig. 37; Mertens und Wermuth, Zool. Jahrb. (Syst.), Band 83, Heft 5, 1955, p. 393.

Gymnopus lineatus Duméril and Bibron, Erpétologie générale, vol. 2, 1835, p. 491.

Diagnosis: Characters of the genus.

Description of species: A very large species, the carapace reaching a length close to a meter. Head elongate, twice as long as wide; eyes placed far forward on the head. A large temporal area not roofed. Head proportionally small; snout rounded. The proboscis as long as eye opening. A single neural plate between first pair of costal bones. Dorsal plates of carapace sculptured and pitted, the anterior parts of epiplastra elongate and narrow,

widely separated from one another. Four plastral callosities. Snout rounded, with a distinct proboscis.

Carapace olive, usually with dark spots or blotches in juveniles. Adults olive, with large yellowish marks or blotches. Black-edged longitudinal streaks on neck and head, with a chevron-shaped mark just preceding disc of carapace.

Measurements: The disc of the carapace is often over 700 mm in length, reaching beyond 800 mm. Dr. Boonsong Lekagul tells me that he captured one reaching approximately a meter in length.

Remarks: This form is sought for as food in the rivers in Thailand. They are sometimes seen in the turtle tanks offered for sale. This species is widely distributed from India through southeastern Asia and Malaya. Due perhaps to its large size few are available in collections. With its large size and a vicious disposition to bite this animal must be considered dangerous to one attempting to capture it. Specimens have been reported from various localities. Besides Thailand it is known from India, Burma, and the Malay Peninsula.

Genus **Dogania** Gray

Dogania Gray, Catalogue of the tortoises, crocodiles and amphisbaenians in the collection of the British Museum, 1844, p. 49 (type of genus, *Trionyx subplanus*).

Diagnosis: Outer extremity of nuchal plate overlying second dorsal rib; 8 neural and 8 costal plates, all of the latter separated from one another by neurals. Hyoplastron distinct from hypoplastron; head large; skull convex above; postorbital arch extremely narrow, its outer margin reduced to an edge; posterior border of pterygoid free, without ascending process. Limbs exposed. Tail short.

Only a single species, *D. subplana,* is known in the genus.

Specimens I have taken are from small streams from low mountains or hills. One young specimen is from a small mountain close to Haadjai, Songkhla; the other is from a small stream at Bhetong, Yala.

Dogania subplana Geoffroy Saint-Hilaire

Trionyx subplanus Geoffroy Saint-Hilaire, Ann. Mus. Hist. Nat. Paris, vol. 14, 1809, p. 11, pl. 5 (type-locality, unknown); Gray, Illustrations of Indian Zoology, vol. 1, 1832, pl. 79; Günther, The reptiles of British India, 1864, p. 49; Boulenger, Catalogue of the chelonians, rhynchocephalians, and crocodiles in the British Museum (Natural History), 1889, p. 246, fig.; The fauna of British India. . . . Reptilia and Batrachia, 1890, p. 11; Flower, Proc. Zool. Soc. London. 1899, p. 619, pl. 36; Boulenger, A vertebrate fauna of the Malay Peninsula. . . . 1912, p. 9.

Trionyx frenatus Gray, Catalogue of the shield reptiles in the collection of the British Museum, 1855, part 1, p. 67 (type-locality, Singapore).

Dogania subplana, Gray, Catalogue of the shield reptiles in the collection of the British Museum, part 1, Testudinata (tortoises), 1855, p 69, pl. 33; Proc. Zool. Soc. London, 1873, p. 57, fig. 8; Annandale, Rec. Ind. Mus., vol. 7, 1912, p. 154; M. Smith, The fauna of British

India. Reptilia and Amphibia, vol. 1, Loricata, Testudines 1931, pp. 164-165; Bull. Raffles Mus., no. 3, 1930, p. 3; Mertens and Wermuth, Zool. Jahrb., Syst., Band 83, Heft 5, 1955, p. 394.

Dogania guentheri Gray, Proc. Zool. Soc. London, 1862, p. 265 (type-locality, "India").

Trionyx dillwynii Gray, Ann. Mag. Nat. Hist., ser. 4, vol. 11, 1873, p. 306 (type-locality, Borneo).

Trionyx pecki Bartlett, Sarawak Gazette, Feb. 1895, p. 30 (type-locality, Borneo).

Diagnosis: A relatively small turtle, 250 mm long; 8 neurals and 8 costals, latter separated from each other by neurals; dorsal skin with numerous longitudinal rows of short flat somewhat elongated tubercles; tail very short; dark olive with a median blackish line and 2 or 3 pairs of black spots which may be outlined in yellow. Proboscis about length of eye opening. A black line through eye running down diagonally; a A-shaped mark between orbits extending on to neck; a short median black line on occiput.

Description of species (from No. 1649, Bhetong, Yala): Carapace flat, longer than wide; anterior border a slightly recurved ridge, crenellated or denticulate; dorsal surface with 20-24 rows of rather elongate tubercles, the more median rows extending length of carapace; 8 costals distinctly outlined, being distinctly granulate or vermiculate and pitted, separated by 8 nearly parallel-sided neurals, likewise sculptured.

Plastron much shorter than carapace; xiphiplastral callosities alone distinguishable. The separation between hyo- and hypoplastra indicated by a lateral groove; head large with free flap of skin turned upward on sides of upper jaws, meeting on midline; a similar flap on lower jaws, directed downwards but not meeting mesially; interorbital distance about half length of bony part of snout; soft proboscis as long as diameter of eye. On hand, 3 claws, the inner largest; 3 claws on foot, all about same length, inner stoutest. On anterior surface of forearm, 3 narrow elongate transverse scales and on leg behind heel a single narrow curved scale, all with free edges.

Color: Blackish to brownish-olive on carapace with a black median line, with 4 rounded blackish spots, each dimly lighter on its edges; plastron whitish or grayish-white; limbs blackish above, grayish below; top of head and neck blackish; underside grayish.

Measurements in mm: Length of carapace, 177; width of carapace, 129; length of plastron, 136; greatest width of hind lobe of plastron, 92; width of head, 40.

Variation: A young specimen had the following colors in life: The plastron was generally gray-olive, the color reaching the periphery in a series of unequal, sometimes rounded, lobules separated by yellowish-brown intervals. These lobules are widest at the periphery but, narrowing quickly, terminate within a few millimeters of the edge; a median, rather ill-defined black line; 4 small black spots symmetrically spaced with scarcely any evidence of lighter edges; a few other black flecks on the carapace; under edge of posterior part of carapace is ivory; the plastron is pinkish-gray, clouded

anteriorly with darker gray; a black line from proboscis passes through eye where it turns down diagonally to a point behind the angles of the jaws. A black line extends from the frontal area to the occiput where it bifurcates, each branch running back diagonally and widening somewhat. A median black line on neck terminates in a black arrowlike mark on the occiput. The sides of neck are pinkish yellow. The top of the head and dorsal area between the black lines are olive and the lips are grayish white reticulated with darker color.

Distribution: I have seen specimens only from the provinces of Songkhla and Yala in Southern Thailand. Elsewhere it occurs in Burma, Malaya, and the Indo-Australian Archipelago. It also reaches as far east as the Philippines.

LORICATA

General Consideration of the Loricata

The crocodiles are reptilian relicts of antiquity quite as much as are the turtles. However, palaeontologists have been able to uncover more of their ancient history and perhaps more is known of their probable origin and evolution than of the turtles. All of the living forms are aquatic, living in fresh water. However, at least one form, and that occurring in our territory, is, at least, largely marine. It is to be seen occasionally along coasts, often several miles from shore presumably enroute to some fresh water lake on a nearby island or to the mouth of some river debouching into the sea. A small lake on the island of Jolo in the southern Philippines in the crater of an ancient volcano with a moderately precipitous crater rim harbors a considerable population of what is believed to be *Crocodilus porosus*.* A place was found—a path—where these animals presumably passed to the ocean which was relatively nearby.

Usually animals of terrestrial ancestry, when they take up an aquatic habitat, they do so because they are unable to obtain a sufficient quantity of food against competitors and are faced with a necessity of changing their habitat to a new food supply or becoming extinct. Usually the new habitat chosen provides food for which there is less competition and the animals will tend to adapt to new foods, and their bodies likewise adapt to the new habitat for greater efficiency in food finding.

Since these animals are easily kept and most zoos have living specimens on exhibition they are well known even to many in areas where there are now none existing in the wild. At present crocodiles are to be found on all the continents except Antarctica. The extent of their distribution is seemingly limited largely by temperature and the presence of available lakes and

* After a small disturbance was made at one edge of the lake, which is perhaps less than one-fifth mile across, some 19 were counted that came to the surface and floated.

rivers. They occur throughout Thailand in practically all suitable areas but where man has hunted them too assiduously they may have become extinct.

One of the detailed early histories of crocodiles is that of Johann Gottlob Schneider (1801). It begins with the comments of Herodotus, Pliny, Strabo, etc. and is brought down to his own time. In this work he treats of the nine known crocodiles, six of which he describes as new. Of these *Crocodylus porosus, C. siamensis* and *C. triagonatus* are still recognized under these names. His *C. longirostris* is now regarded a synonym of *Gavialis gangeticus, C. sclerops* a synonym of *Caiman crocodilus crocodilus,* and *Crocodylus oophilus* is regarded a synonym of *Crocodylus porosus.* Two of the species were from Thailand.

Duméril and Bibron in their Erpétologie Générale vol. 4, 1836, treat of the crocodiles under three groups which they call the Caimans, the Crocodiles, and the Gavials. They recognize 13 species with several varieties.

Boulenger (1889b) reviewed the crocodiles, treating them under one family, 6 genera and 22 species. One other genus, *Perosuchus* of Cope was regarded as doubtfully placed.

Mook (1921d) presented the skull and skeletal characters of the Crocodilidae in excellent detail. These were treated under 8 genera and 20 species.

Wermuth (1953) reviews the *Crocodylia* under three families: Alligatoridae with the genera *Alligator, Melanosuchus, Caiman,* and *Paleosuchus;* Family Crocodylidae with *Osteoblepharus, Crocodylus, Osteolaemus,* and *Tomistoma;* Family Gavialidae with a single genus, *Gavialis.*

Since the publication of this work very few changes have been proposed, none of which affect the forms in Thailand. In this country Malcolm Smith (1916c, p. 49) reports *Tomistoma schlegelii, Crocodylus porosus,* and *C. siamensis.* It has long been presumed that *C. palustris* was present in the country since it is known in Burma and in the southern part of the Malay Peninsula. However, Smith (1919a) asserts: "After examining a large number of crocodiles from various parts of Siam, I am convinced that it *(palustris)* does not occur anywhere in that country."

Of course, it is not impossible that they do occur and they should be looked for. Their present known distribution strongly suggests their presence at least in the upper part of the Peninsula in Thailand. The species is included in the key.

TAXONOMIC TREATMENT

SYNOPSIS OF THE THAI SPECIES OF THE CROCODYLIDAE

I. Snout 3.0 to 3.5 times as long as broad at the base; nuchal and dorsal scutes forming a single continuous shield composed of 22 transverse series, the broadest of which contain 6 scutes, the four anterior (nuchals) only 2 scutes—all keeled; 2 small occipital scutes; fingers webbed at base; outer toes extensively webbed. A

strong "crest" on the outer edge of the leg; scales on limbs keeled. Olive above with dark spots or cross-bands; length to 4.5 meters ..... *Tomistoma schlegelii*

II. Snout more than 1.5 and not more than 2.25 times as long as broad at the base; mandibular symphysis extending to the level of the fourth or fifth tooth; premaxillo-maxillary suture extended posteriorly on palate ..... *Crocodylus* 2

No longitudinal ridge in front of eye; anterior nuchal scutes (postoccipitals) well developed; a longitudinal ridge between orbits, none on snout ..... *Crocodylus siamensis*

A longitudinal ridge in front of each eye; anterior nuchal series usually absent ..... *Crocodylus porosus*

III. Snout not more than 1.5 times as long as broad at base; mandibular symphysis extending to level of fourth or fifth tooth; premaxillary-maxillary suture on the palate transverse or curved forwards; snout without ridges; dorsal shield usually composed of four longitudinal series of scutes, the median of which are broader than long ..... *Crocodylus palustris*

Genus **Crocodylus** Laurentus

Crocodylus Laurentus, Synopsis Reptilium, 1768, p. 53 (type of genus *Crocodylus niloticus*).

Crocodilus Bonnaterre, Tableau encyclopedique et Methodique des trois Règnes de la nature, Erpétologie, 1789, p. 32; Boulenger, Catalogue of the chelonians, rhynchocephalians, and crocodiles in the British Museum (Natural History), 1889, p. 277.

Champse Merrem, Vers. Syst. Amph., 1820, p. 36; Werner, Loricata, Das Tierreich, Lief. 62, 1933, pp. 1-40.

Tomistoma S. Müller, Arch. Naturg. Berlin, 1846, Band 12, p. 122; Krefft, Proc. Zool. Soc. London, 1873, p. 334.

Gray has recognized several other nominal genera: *Mecistops, Oophilus, Palinia, Molinia, Bombifrons, Temsacus, Philas.* These generally have been regarded as synonyms of *Crocodylus.*

Crocodylus siamensis Schneider

(Fig. 14)

Crocodylus siamensis Schneider, Historiae amphibiorum naturalis et literariae, fasc. 2, 1801, p. 159 (type-locality, Siam); Günther, Reptiles of British India, 1864, p. 61, pl. 8, fig. b; Strauch, Syn. Crocod., 1866, p. 50; Boulenger, Catalogue of the chelonians, rhynchocephalians and crocodiles in the British Museum, London, 1889, p. 282; M. A. Smith, Nat. Hist. Soc. Siam, vol. 3, 1919, p. 217, 3 pls.; Bull. Raffles Museum, no. 3, 1930, pl. 1; Wermuth, Mitteil. Zool. Mus. Berlin, Band 29, Heft 2, 1953, pp. 481-483, figs. 48, 49.

Crocodilus galeatus, Cuvier, Ann. Mus. Hist. Nat. Paris, vol. 10, 1807, p. 51, pl. 1, fig. 9; Duméril and Bibron, Erpétologie Générale, vol. 3, 1839, p. 113.

Crocodilus vulgaris, Schlegel and Müller *(part.) in* Temminck, Ver. Nat. Gesch. Nederland Indies, Rept. 1844, p. 28, pl. III, fig. 9.

Crocodilus palustris, Laidlaw, Proc. Zool. Soc. London, 1901, p. 58 (Patani).

Bombifrons siamensis, Gray, Ann. Mag. Nat. Hist., ser. 3, vol. 10, 1862, p. 269.

Diagnosis: A total of 17 or 18 teeth on each side of upper jaw, 4 or 5 of which are on each premaxillary; snout less than twice as long as wide at base.

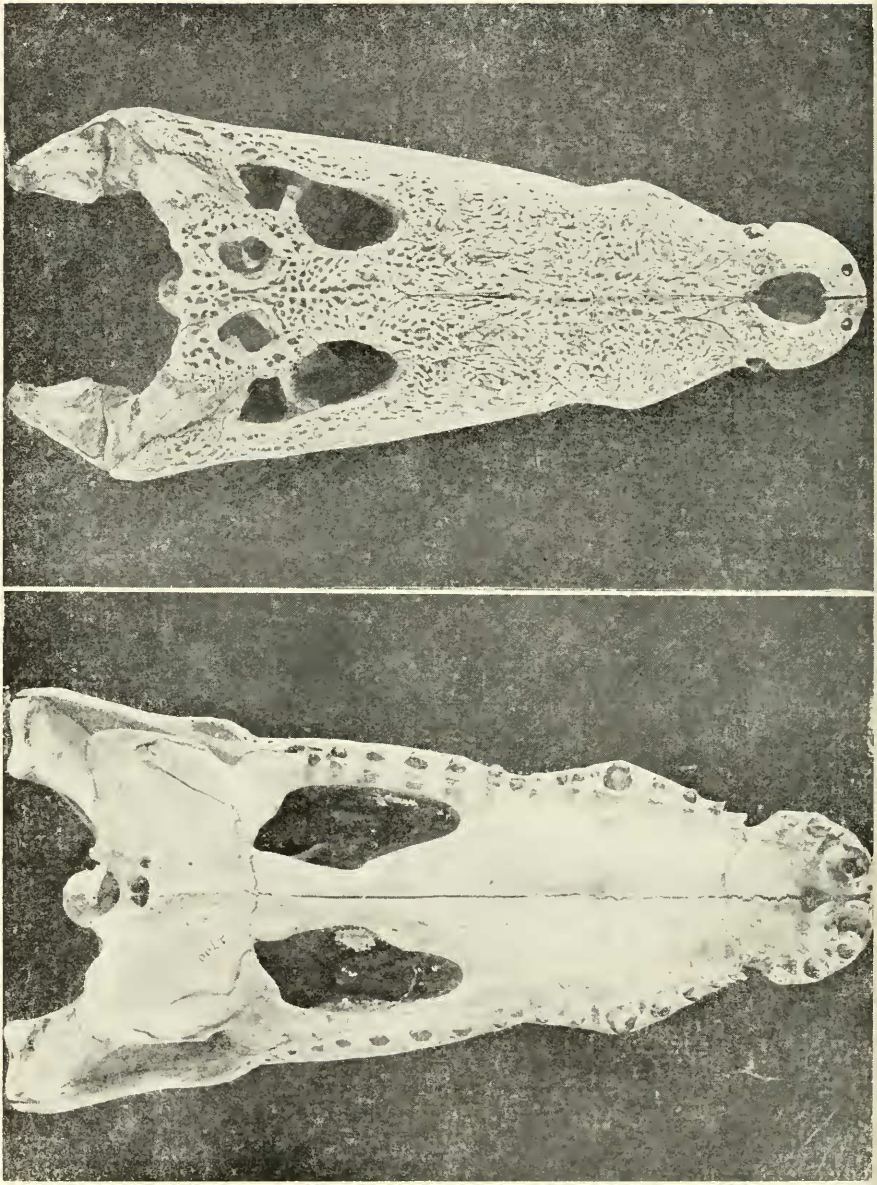

FIGURE 14. *Crocodylus siamensis* Schneider. Skull. From upper, dorsal; lower, ventral view.

On nuchal region, usually if not invariably, two large pairs of scutes each bordered laterally by a single enlarged scute. Preceding these a transverse row of 4 somewhat smaller scutes separated well from the nuchals. Olive to brownish above; whitish or yellowish below. Young specimens may be black-spotted. A serrate fringe on outer side of limbs.

Description of species: Dorsal surface of snout relatively smooth, area about nostrils somewhat elevated, Area preceding and between eyes definitely concave, the cranial table nearly square, slightly concave. Posterior to cranial table scales small, transversely arranged. There follows four rather enlarged scutes separated mesially, all keeled; following several transverse rows of very small scales are two pairs of much enlarged scutes making contact mesially with a single much enlarged scute lateral to each of these pairs. On dorsum of body, 16 or 17 transverse rows of enlarged scutes in six longitudinal series, the bony portion of the scutes contiguous with one another. The number of scutes in the transverse rows reduce to 2 on the tail for some distance.

The skull has 17 or 18 teeth on both sides of the upper jaw, 4 or 5 confined to the premaxillary; the premaxillo-maxillary suture curves backwards. The snout is 1.5 to 1.66 times as long as wide measured just in front of orbits. A distinct ridge runs forward a distance anterior to the orbits, converging slightly. A small poorly developed ridge in interorbital region usually present. The mandibular symphysis extending to fourth tooth.

Color: Usually olive or greenish olive to brown, somewhat variegated. The young usually spotted black, and generally paler above. The tail is banded in black.

Measurements: The species is known to reach a length of 3.5 meters and may even reach 4 meters. The tail constitutes approximately half the length.

Distribution: The species occurs in Thailand both in the central part and in peninsular areas. There are reports that the species is common in the river Quae (Quae Noi), Western Thailand. (from literature).

Remarks: Malcolm Smith (1919a), who has made the greatest contribution to the herpetological knowledge of Thailand, gives a detailed account of this species (pp. 217-220).

Crocodylus porosus Schneider

(Fig. 15)

Crocodilus porosus Schneider, Historiae amphibiorum naturalis et literariae, fasc. segundus, 1801, pp. 159-160 (type-locality not given); Gray, Catalogue of the tortoises, crocodiles, and amphisbaenians in the collection of the British Museum, 1844, pp. 1-40. Günther, Reptiles of British India, 1864, p. 62, pl. 7; Boulenger, Catalogue of the chelonians, rhynchocephalians, and crocodiles in the British Museum, 1889, pp. 284-285.

Crocodilus oophilus Schneider, Historiae amphibiorum . . . fasc. segundus, 1801, pp. 165-166.

Crocodilus biporcatus raninus Schlegel & Müller, Verh. Nat. Gesch. Nederl. Besitt., Rept., 1844, p. 28.

Oophilus porosus Gray, An. Mag. Nat. Hist., ser. 3, vol. 10, 1862, p. 267; Trans. Zool. Soc., vol. 6, 1867, p. 138; Catalogue of the shield reptiles, 1872, pt. 2, p. 8.
Crocodilus pondicerianus Gray, Ann. Mag. Nat. Hist., ser. 3, vol. 10, 1862, p. 267; Günther, Reptiles of British India, 1864, p. 62, pl. 7.

Diagnosis: Head somewhat triangular, relatively short. A pair of ridges extending forward on the skull between eyes, then curving slightly outward and then inward, the discontinuous ridges converging slightly; 3 large nuchals, often not contiguous, on each side; usually no enlarged occipital scutes preceding nuchal scutes.

Description: A very large species, reputedly reaching a length rarely of about 10 meters. Snout moderately long, narrowed back of level of nostrils, elevated somewhat near tip. Cranial table somewhat concave as are interorbital areas. No enlarged postoccipital scutes (except occasionally in young specimens, and some Ceylonese specimens may have 2 or, more rarely, 4). Dorsal scutes in 16-17 transverse rows and 6 to 8 contiguous or nearly contiguous longitudinal series, the scales regular, separated from the enlarged nuchals, all keeled. Enlarged nuchals, 4 to 6 slightly separated or contiguous, the four median forming a square. Most lateral scales and those on limbs keeled. Fingers webbed at base; toes with much web. A fringe of scutes on outer posterior part of leg.

Skull with 17 to 19 teeth in upper jaw; mandibular symphysis extending to fifth tooth; premaxillomaxillary suture on palate directed backwards or W-shaped. Nasal bones separating the premaxillaries above.

Color: Generally dark olive dorsally. The young specimens are lighter, usually spotted with black. Small dots on head. Venter yellowish.

Measurements of skull in mm: Tip of snout to supraoccipital 642; tip of snout to end of quadrates, 721; length of snout, 464; skull width across quadratojugals, 369; width of cranial table (posterior end), 177; width at base of snout, 220; width across narial opening, circa 158; length of mandible, 785; width of mandible, 390 (American Mus. No. 15179). (from Mook 1921d).

Remarks: Crocodilus porosus grows to a known size probably greater than other living Crocodilia. Smith (1931a) reports one from northern Queensland measuring 9 meters 70 cm (about 32 feet). Another report, perhaps less well authenticated, reports one with a probable length of 33 ft! Barbour (1924a) reports a Philippine specimen with a length of 29 ft., a girth behind forelimbs of 11 ft., and a skull 34.75 in. long (now in Mus. Comp. Zool., Harvard College).

A specimen captured in the mouth of a Batangas river debouching into Manila Bay was captured by General Aquinaldo. I had the 18 foot specimen mounted for exhibition, but it was later destroyed at a fire at the Manila Carnival where it was temporarily on exhibition.

For the most part *C. porosus* prefers salt water and usually occupies the river mouths and coastal waters. They are often seen swimming at sea and

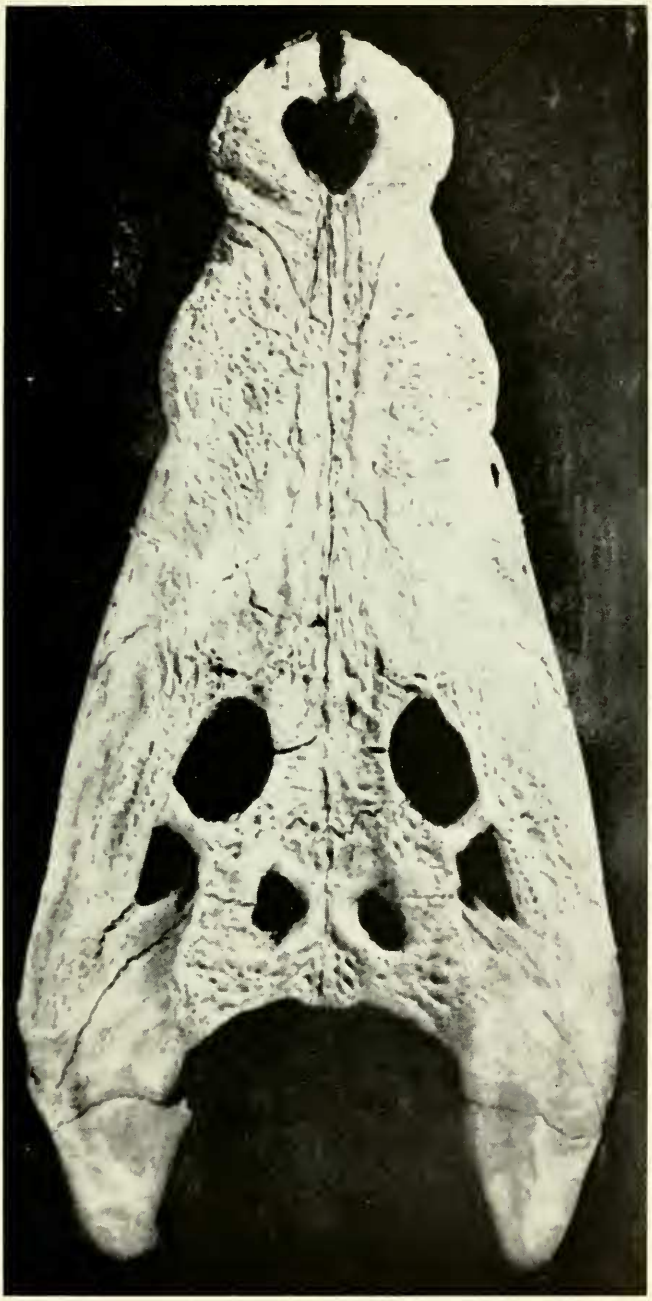

FIGURE 15. *Crocodylus porosus* Schneider. Amer. Museum Nat. Hist. No. 15179. Skull length, 642 mm. From Mook (1921a, fig. 4).

have been reported 40 miles from the nearest land. As a result of this habit the species has spread more widely than other crocodiles. One of course cannot rule out the possibility that they may have also been transported by man. They are known from estuaries of Thai rivers, Gulf of Thailand, Coasts of India, Ceylon, Philippines, Vietnam, Cambodia, Hong Kong, Solomon Islands and Fiji, and some Indo-Australian Islands.

Karl Schmidt (1928a) has reported the species as being seen in fresh water 60 miles from the sea. M. L. Smith (1931a) believes that in Thailand they normally do not ascend rivers and are normally inhabitants of the mouths of muddy rivers. Smith calls it the "Estuarine Crocodile."

Genus **Tomistoma** S. Müller

Crocodilus S. Müller, Tijdsch. Nat. Gesch., Amsterdam and Leiden, 1838, vol. 5, p. 17.

Mecistops (part.) Gray, Catalogue of tortoises, crocodiles and amphisbaenians in the collection of the British Museum, 1844, p. 57.

Tomistoma S. Müller, Arch. f. Nat., 1846, p. 122; Gray, Catalogue of shield reptiles in the collection of the British Museum, Pt. II, Emydosaurians, rhynchocephalians, and amphisbaenians, 1872, p. 6; Boulenger, A vertebrate fauna of the Malay Peninsula from the Isthmus of Kra to Singapore, Reptilia and Batrachia, 1912, pp. 3-4; Mook, Bull. Amer. Mus., vol. 44, 1921, p. 140; Wermuth, Mitt. Zool. Mus. Berlin, Band 29, Heft 2, Dec. 1953, pp. 500-501; Mertens and Wermuth, Zool. Jahrb. (Syst.), 1955, Band 85, Heft 5, p. 412.

Rhynchosuchus Huxley, Jour. Proc. Linn. Soc. Zool., vol. 4, p. 16, 1859.

The type of the genus is *Tomistoma schlegelii* S. Müller. The species occurs on the Asiatic mainland as far north as southern Thailand. It is known on the islands of Borneo and Sumatra, and doubtless occurs on certain other Indonesian islands.

Diagnosis: Snout long, narrow; four longitudinal series of juxtaposed keeled bony scutes on the back. There are 20 to 21 premaxillomaxillary teeth; 18 to 19 dentary teeth, the latter received into interdental pits; fifth maxillary tooth largest, lateral. First and fourth dentary teeth fit into upper jaw notches; nasal bones do not reach the nasal openings by a considerable distance but are in contact with the premaxillaries for some distance. Nasal opening somewhat pear-shaped, not as large as the supratemporal fossa; a small palpebral bone.

Dentary bones slender, forming a common suture back to level of contact with the splenials, the suture being continued one third farther back between the splenials.

Tomistoma schlegelii (S. Müller)

(Figs. 16-17)

Crocodilus (Gavialis) schlegelii S. Müller, Tijdsch. Nat. Gesch., vol. 5, 1838, p. 77 (type-locality, South Borneo).

Tomistomia schlegelii S. Müller, Archiv. für Naturg., Band 12, 1846, p. 122; Boulenger, Catalogue of the chelonians, rhynchocephalians, and amphisbaenians in the British Museum, 1889, p. 276; Proc. Zool. Soc. London, 1896, p. 628; Flower, Proc. Zool. Soc. London,

1899, p. 622; Butler, Jour. Fed. Malay States Mus., vol. 1, 1905, p. 1; Boulenger, A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, pp. 3-4; Mook, Bull. Amer. Mus. Nat. Hist., vol. 44, 1921, pp. 140-151, fig. 2 (skeletal study); Wermuth, Mitt. Zool. Mus. Berlin, Band 29, Heft 2, 1953, pp. 501-503, figs. 63 (head) 64, skull; Mertens and Wermuth, Zool. Jahrb. (Syst.), 1955, Band 83, Heft 5, p. 412.

Diagnosis: Characters of the genus.

Description: From a juvenile specimen (unnumbered) Chulalongkorn Univ., from Southern Thailand. May 10, 1958. Prepared skull, and literature.

Head slender, the snout extended greatly; the width of the snout at middle, about 9 or 10 times, in its length (to last tooth or front level of orbit), the snout widening in front of orbits; upper jaw extending several millimeters beyond the dentaries, the two terminal teeth directed straight downward; postoccipital scutes small, in several indefinite, inconspicuous rows; six nuchals forming two rows of paired scales, seemingly not separated from the dorsals; body with a dorsal squamation consisting of a longitudinal series of juxtaposed bony scutes extending from the nuchal region, composed of 22 transverse series, of from two to six scales in width. Two small postoccipital scutes. A well-developed basal web on toes; fingers webbed at their base. A crest bordering outer edge of leg. Scutes on legs and arms keeled.

Color: Generally dull olive or greenish, with dark brown spots. Posterior dorsum and tail sometimes with transverse bands and spots; whitish beneath; iris yellowish brown.

Measurements in mm: Total skull length including jaws, 260; length of skull, snout tip to condyle, 227; skull to front edge of orbits, 75; snout, front of orbits to snout tip, 164; width of snout in front of orbits, greatest, 40; narrowest width preceding orbits, 14; length of orbit, 28; greatest skull width, 79; length of lower jaws, 254.

Mook gives measurements in mm of a skull (American Museum no. 15177), as follows: Snout tip to supraoccipital, 765; to end of quadrates, 842; snout length, 577; length of lower jaw, 935; width interorbital space, 40; width across quadratojugals, 352.

Adults are said to reach a length of about 17 ft.

Distribution: In Thailand the species has been taken only in the southern part. The type-locality is the Perak river close to the southern border of Thailand. Specimens have been taken in Borneo and Sumatra. It most probably occurs on some of the other islands of the Indo-Australian Archipelago.

Remarks: The species is reputed to feed chiefly on fish and has not been known to attack human beings.

Tomistoma shows a strong resemblance to *Gavialis* of India. Despite the fact that they have been associated with *Gavialis* by various authors, it would appear that it is actually a member of the family Crocodilidae rather than Gavialidae.

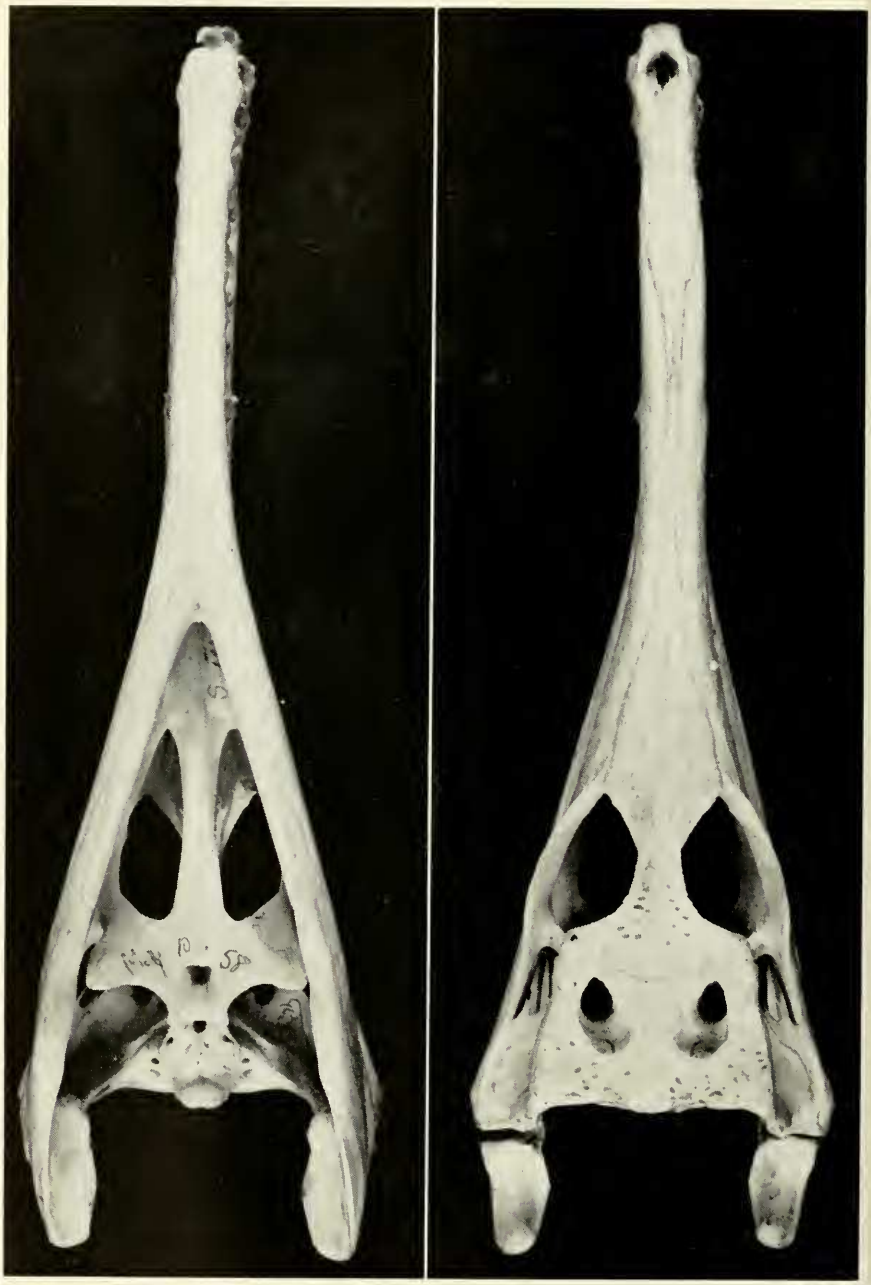

FIGURE 16. *Tomistoma schlegelii* S. Müller. Chulalongkorn Univ. No. 58 (young). "Southern Thailand." Actual skull length, 260 mm. Ventral view, left; dorsal view, right.

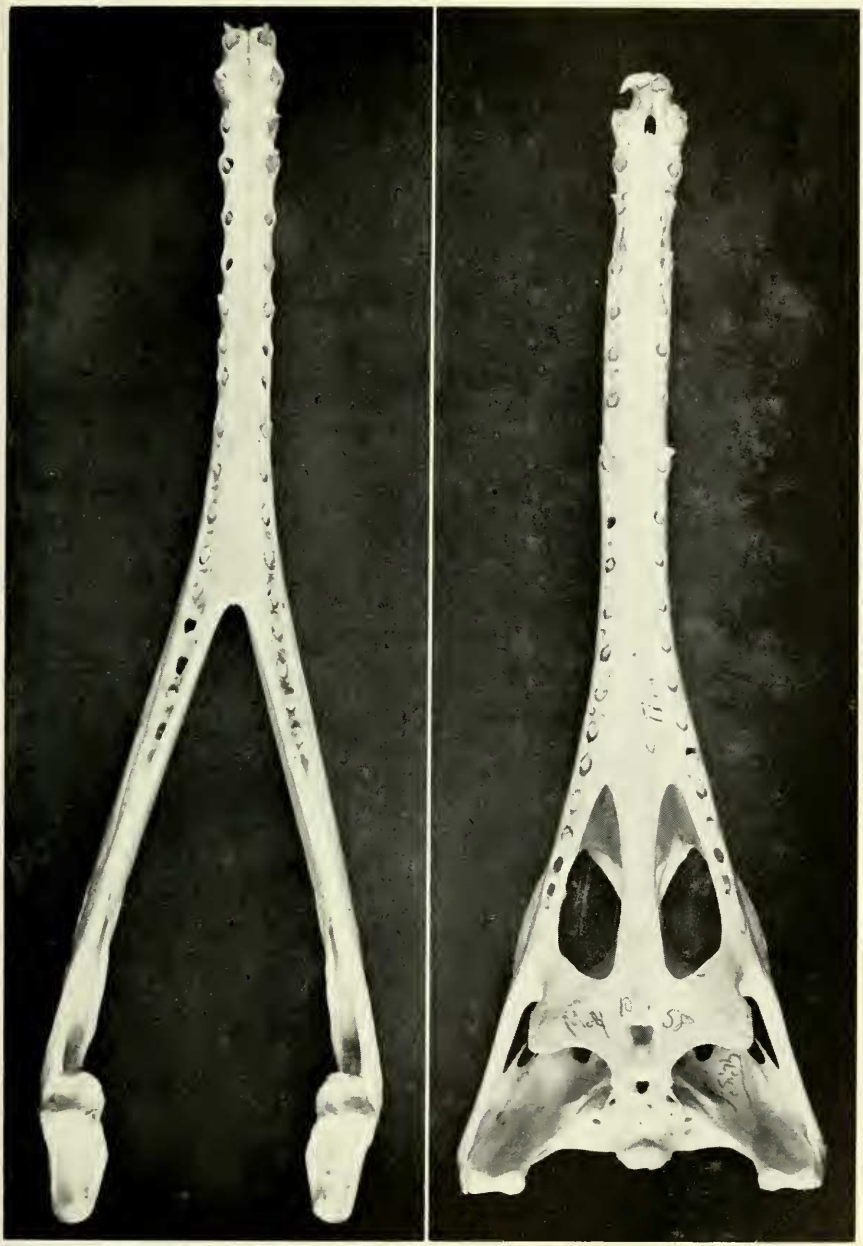

FIGURE 17. *Tomistoma schlegelii* S. Müller. Chulalongkorn Univ. No. 58 (young). "Southern Thailand." Left, upper view of lower jaw; right, ventral view of skull. Skull length, 260 mm.

The skull of *Tomistoma* may easily be distinguished from *Gavialis,* having the maxillary bones in contact for nearly half the length of the snout. In *Tomistoma* the maxillaries are completely separated by contact of the premaxillaries and nasals.

Mook (1921d) writes: The characters of the genus *(Gavialis)* differ widely from those of other living crocodilians. In spite of the fact that *Tomistoma* is in many respects intermediate between this genus and *Crocodilus* there is no appreciable graduation in characters between the gavial and the true crocodiles, *Tomistoma* being much closer to crocodiles than to *Gavialis.*

SYNOPTIC BIBLIOGRAPHY

Note. In the publication of the four volumes on the Herpetology of Thailand (The Amphibian Fauna of Thailand, 1962; The Lizards of Thailand, 1963; The Serpents of Thailand and Adjacent Waters, 1965; and the present volume, all published in the University of Kansas Science Bulletin) it was deemed wise to publish a single bibliography covering the whole series in the last volume. The unfortunate delay in publication of the fourth part was not anticipated.

(ANON.) 1952. Breeding of the Leathery turtle, *Dermochelys coriacea* Linn. Rep. Raffles Mus., 1952 (1953), pp. 8-10, fig.

AAGAARD, C. J. 1924. Cobras and king-cobras. Jour. Nat. Hist. Soc. Siam, vol. 6, pp. 315-316.

ABERCROMBY, A. F. 1922. Crocodile *(C. palustris)* burying its food. Jour. Bombay Nat. Hist. Soc., vol. 28, p. 533.

ALCOCK, A., and L. ROGERS. 1902. On the toxic properties of the saliva of certain "non poisonous" colubrines. Proc. Royal Soc. London, vol. 70, pp. 446-454.

ANDERSON, JOHN. 1871. Description of a new genus of newts from Western Yunnan. Proc. Zool. Soc. London, 1871, pp. 423-425, fig.

———. 1872. On *Manouria* and *Scapia,* two genera of land-tortoises. Proc. Zool. Soc. London, 1872, pp. 132-144, text-figs. 1-9.

———. 1889. Report on the mammals, reptiles, and batrachians chiefly from the Mergui Archipelago, collected for the trustees of the Indian Museum. (The fauna of Mergui.) Jour. Linn. Soc., vol. 21, pp. 331-350.

ANDERSSON, LARS GABRIEL. 1916. Zoological results of the Swedish Zoological Expedition to Siam. 1911-1912, and 1914. III. Batrachians. Bih. Till. K. Svenska. Vet.-Akad. Handl. Stockholm, Band 55, No. 4, pp. 13-17.

ANGEL, FERNAND. 1920a. Sur un saurien nouveau de la famille des Ophiopsisepidés. Bull. Mus. Hist. Nat. Paris, vol. 26, pp. 4-6.

———. 1920b. Liste de reptiles recemment determinés et entrés dans les collection et descriptions d'une nouvelle espèce du genre *Amblycephalus.* Bull. Mus. Hist. Nat. Paris, vol. 26, pp. 112-114.

———. 1927. Liste des reptiles et des batraciens rapportes de l'Indo-Chine, par. M. P. Cheney. Description d'une varieté nouvelle de *Simotes violaceus* Cantor. Bull. Mus. Hist. Nat. Paris, vol. 33, pp. 496-498.

———. 1928. Reptiles et batraciens recueillis en Indo-Chine par la mission de M. M. Delacour et Lorne. Bull. Mus. Hist. Nat. Paris, 1928, pp. 445-447.

———. 1929. Liste des reptiles et batraciens du Haut-Laos recuellis par M. Delacour. Description d'un genre, de deux espèces et d'une varieté d'Ophidiens. Bull. Mus. Hist. Nat. Paris, Tome 2, pp. 75-81.

ANNANDALE, NELSON. 1909. Notes on Indian Batrachia. Rec. Ind. Mus. Calcutta ,vol. 3, pp. 282-286.

———. 1912a. Zoological results of the Abor Expedition, 1911-1912. Reptilia. Rec. Ind. Mus., vol. 8, pp. 37-55, 1 pl. Also supplement, vol. 8, pp. 357-358.

———. 1912b. The rupture of the egg-shell in the genus *Calotes.* Jour. Bombay Nat. Hist. Soc., vol. 21, pp. 1099-1100.

———. 1913a. Some new and interesting Batrachia and lizards from India, Ceylon, and Borneo. Rec. Ind. Mus., vol. 9, 301-307, pl.

———. 1913b. The Indian geckos of the genus *Gymnodactylus*. Rec. Ind. Mus., vol. 9, pt. 5, no. 21, pp. 309-326, pls. 16-17.

———. 1916. Preliminary report on the fauna of the Talé Sap or inland Sea of Singora. Jour. Nat. Hist. Soc. Siam, II, pp. 90-102.

———. 1917. Zoological results of a tour in the far east. Batrachia. Mem. Asiat. Soc. Bengal, vol. 6, pp. 119-155, 2 pls.

ANNANDALE, NELSON, and F. H. GRAVELY. 1913. The limestone caves of Burma and the Malay Peninsula. II. Fauna (Reptilia and Batrachia), Jour. Asiat. Soc. Bengal, vol. 9, pp. 391-441.

ANNANDALE, NELSON, and H. C. ROBINSON. 1903. Anthropological and zoological results of an expedition to Perak and the Siamese Malay States 1901-1902 . . . undertaken under the auspices of the University of Liverpool. Fasciculi Malayenses. Zool., vol. 1, pp. 1-300, pls. V-X.

AOTA, S. 1940. A histological study on the integument of a blind snake (*Typhlops braminus* Daudin), with special reference to the sense organs and nerve ends. Jour. Sci. Hiroshima Univ., Zool., vol. 7, pp. 193-207, text figs.

ASANA, J. J. 1930. The natural history of *Calotes versicolor*, the common blood-sucker. Jour. Bombay Nat. Hist. Soc., vol. 34, pp. 1041-1047.

BABCOCK, HAROLD L. 1930. Variations in the number of costal shields in *Caretta*. Amer. Nat., vol. 64, pp. 95-96.

BANNERMAN, W. B. 1907. A further note on the distribution of the varieties of cobra in India. Jour. Bombay Nat. Hist. Soc., vol. 17, pp. 1031-1032.

BANNERMAN, W. B., and J. B. POCHA. 1905. On the distribution of the varieties of cobra *(Naia tripudians)* in India. Jour. Bombay Nat. Hist. Soc., vol. 16, pp. 638-643, 4 maps.

———. 1906. Note on the breeding of Russell's viper *(Vipera russelli)* in captivity. Jour. Bombay Nat. Hist. Soc., vol. 17, pp. 808-811.

BARBOUR, THOMAS. 1909. Notes on Amphibia and Reptilia from eastern Asia. Proc. New England Zool. Soc., vol. 4, pp. 53-78, pls. 6-7.

———. 1912a. A contribution to the Zoogeography of the East Indian Islands. Mem. Mus. Harvard College, vol. 44, pp. 1-203, pls. 1-8.

———. 1912b. *Physignathus cocincinus* and its subspecies. Proc. Biol. Soc. Washington, vol. 25, pp. 191-192.

———. 1924a. A record crocodile *Crocodilus porosus*. Singapore Nat., no. 4, p. 88.

———. 1924b. A Yunnan Gecko. Occ. Papers Boston Soc. Nat. Hist., vol. 5, p. 133-135, text fig.

BARRON, P. A. R. 1918. A new snake and a new batrachian from Siam. Jour. Nat. Hist. Soc. Siam, vol. 3, no. 1, pp. 45-46.

———. 1919. On the breeding of the toad *Bufo macrotis*. Jour. Nat. Hist. Soc. Siam, vol. 3, no. 3, p. 230.

BEDDARD, FRANK E. 1907. Notes upon the anatomy of a species of frog of the genus *Megalophrys* with references to other genera of Batrachia. Proc. Zool. Soc. London, 1907, pp. 324-352, figs. 95-100.

BEDOT, M. 1909. Sur la faune de l'Archipel Malais (résumé). Genève Rev. Suisse Zool., vol. 17, pp. 143-169.

BELL, THOMAS. 1825a. A monograph of the tortoises having a movable sternum, with remarks on their arrangement and affinities. Zool. Jour. London, vol. 2, pp. 299-310.

———. 1825b. Characters of the Order, Families and Genera of the Testudinata. Zool. Jour. London, vol. 3, pp. 513-516.

———. 1836-1842. A Monograph of the Testudinata. London. 63 colored plates.

BENYAJATI, C., M. KEOPLUNG and R. SRIBHIBHADH. 1960. Viper bite in Thailand, with notes on treatment. Jour. Trop. Med. Hyg., vol. 63, pp. 257-260.

———. 1961. Experimental and clinical studies in glucocorticoids in cobra envenomation. Jour. Trop. Med. Hyg., vol. 64, pp. 46-49.

BERRY, P. Y., and JOHN R. HENDRICKSON. 1963. *Leptobrachium nigrops*, a new pelobatid frog from the Malay Peninsula, with remarks on the genus *Leptobrachium* in Southeastern Asia. Copeia, 1963, no. 4, Dec. 31, pp. 643-648, text figs. 1-4.

BLANFORD, WILLIAM THOMAS. 1881a. On a collection of reptiles and frogs, chiefly from Singapore. Proc. Zool. Soc. London, 1881, pp. 215-227.

———. 1881b. Notes on an apparently undescribed *Varanus* from Tenasserim, and other Reptilia and Amphibia. Jour. Asiat. Soc. Bengal, ser. 2, vol. 1, pp. 239-243, 1 pl.

BLEEKER, P. V. 1858. De heer Bleeker deelt mede dat hij dezer weder eene verzameling reptilian en visschen van Sinkawang (Westkust van Borneo). No. 7. ontvangen heeft. Natuurk. Tijdschr. Nederl. Ind., Batavia, vol. 16, p. 188.

———. 1859. Reptilien van Agam. Naturrk. Tijdschr. Nederl. Ind., vol. 20, pp. 325-329.

BOCOURT, FERMIN. 1866. Notas sur les reptiles, les batraciens et les poissons, recueillis pendant un voyage dans le Royaume de Siam par M. Bocourt. Nouv. Arch. Mus. Hist. Nat. Paris, vol. 2 (2), pp. 4-20.

BOETTGER, OSKAR. 1888. Materialien zur herpetologischen fauna von China. II. I. Liste der zweiten von Moellendorff'schen und der Herz'schen und Schmaker'schen Sendungen chinesischer Kriechtiere. II. Ernente Aufzählung der Reptilian und Batrachier des Chinesischen Reiches. Ber. Senck. Ges., 1888, pp. 53-59, 93-102, 154-191, pls.

———. 1892. Katalog der Batrachier-Sammlung im Museum des Senckenbergeschen naturforschenden Gesellschaft in Frankfurt am Main. Frankfurt am M., pp. I-X, 1-78.

———. 1893a. Eine neuer Drache *(Draco)* aus Siam. Zool. Anz., Leipzig, 1893, pp. 429-430.

———. 1893b. Katalog der Reptilien-Sammlung im Museum der Senckenbergeschen naturforschenden Gesellschaft in Frankfurt am Main (Rhynchocephalan-Schildkroten Krokodile Eidechsen, Chamäleons). Pt. 1, pp. I-X, 1-140.

———. 1898. Katalog der Reptilien-Sammlung im Museum der Senckenbergeschen naturforschenden Gesellschaft in Frankfurt am Main pt. II, Schlangen. pp. I-XI, 1-160.

———. 1901. Aufzahlung einer Liste von Reptilien und Batrachiern aus Annam. Ber. Senckenbergischen Nat. Gesells. in Frankfurt am Main, 1901, pp. 45-53.

BOSCHMA, H. 1925. On the color changes in the skin of the lizard *Ptychozoon homalocephalum*. Biol. Bull., vol. 48, pp. 446-454, text figs. 1-6.

BOULENGER, GEORGE ALBERT. 1882a. Catalogue of the Batrachia Gradientia *s.* Caudata and Batrachia Apoda in the collection of the British Museum, 2nd ed., pp. I-VIII, 1-127, pls. 1-9.

———. 1882b. Catalogue of the Batrachia Salientia *s.* Ecaudata in the collection of the British Museum, 2nd ed., pp. I-XVI, 1-503, pls. 1-30, numerous unnumbered text figures.

———. 1885. Description of a new frog of the genus *Megalophrys*. Proc. Zool. Soc. London, 1885, p. 850, pl. 55.

———. 1885-1887. Catalogue of the Lizards in the British Museum Natural History, vols. 1-3 (2nd ed.). Vol. 1. Geckonidae, Eublepharidae, Uroplatidae, Pygopodidae, Agamidae, 1885, pp. 1-436, pls. 1-32. Vol. 2. Iguanidae, Xenosauridae, Zonuridae, Anguidae, Anniellidae, Helodermatidae, Varanidae, Xantusidae, Teiidae, Amphisbaenidae, 1885, pp. 1-497, pls. 1-24. Vol. 3. Lacertidae, Gerrhosauridae, Scincidae, Anelytropidae, Dibamidae, Chamaeleontidae, 1887, pp. 1-575, pls. 1-40.

———. 1887a. Description of a new frog of the genus *Megalophrys*. Ann. Mus. Civ. Stor. Nat. Genova, ser. 2, vol. 4, pp. 512-513.

———. 1887b. An account of the scincoid lizards collected in Burma for the Genoa Civic Museum by Messrs. G. B. Comotto and M. L. Fea. Ann. Mus. Civ. Stor. Nat. Genova, ser. 2, vol. 4, pp. 618-624.

———. 1887c. On new batrachians from Malacca. Ann. Mag. Nat. Hist., ser. 5, vol. 19, pp. 344-348, pl. 10.

———. 1887d. An account of the batrachians obtained in Burma by M. L. Fea of the Genova Civic Museum. Ann. Mus. Civ. Stor. Nat. Genova, ser. 2, vol. 5, pp. 418-424 (Separate pp. 1-7), pls. 3-5.

———. 1887e. An account of the reptiles and batrachians obtained in Tenasserim by G. B. Commoto and M. L. Fea of the Genova Civic Museum. Ann. Mus. Civ. Stor. Nat. Genova, ser. 2, vol. 5, pp. 474-486, pls. 6-8.

———. 1887f. Notes on the osteology of the genus *Platysternum*. Ann. Mag. Nat. Hist., ser. 5, vol. 19, pp. 461-463, pls. 16-17.

———. 1888. An account of the reptilia obtained in Burma north of Tenasserim by M. L. Fea of the Genova Civic Museum. Ann. Mus. Civ. Stor. Nat. Genova, ser. 2, vol. 6, pp. 594-604, pls. 5-7.

———. 1889a. Description of a new batrachian of the genus *Leptobrachium* obtained by M. L. Fea in the Karens Mountains, Burma. Ann. Mus. Civ. Stor. Nat. Genova, ser. 2, vol. 7, pp. 748-750.

———. 1889b. Catalogue of the Chelonians, Rhynchocephalians, and Crocodiles in the British Museum (Natural History), new ed., pp. I-X, 1-311, pls. 1-6, text figs. 1-73.

———. 1890a. The Fauna of British India, including Ceylon and Burma. Reptilia and Batrachia, 1890, pp. I-XVIII, 1-541, text figs. 1-142.

———. 1890b. List of the reptiles, batrachians and freshwater fishes collected by Professor Moesch and Mr. Inversen in the district of Deli, Sumatra, Proc. Zool. Soc. London, 1890, pp. 31-40.

———. 1891. On new and little-known Indian and Malayan reptiles and batrachians. Ann. Mag. Nat. Hist., ser. 6, vol. 8, pp. 288-292.

———. 1893. Concluding report on the reptiles and batrachians obtained in Burma by Signor L. Fea, dealing with the collection made in Pegu and the Karin Hills in 1887-1888. Ann. Mus. Civ. Stor. Nat. Genova, ser. 2, vol. 13, pp. 304-347, pls. 7-11. (In separate, pp. 1-44.)

———. 1893-1896. Catalogue of the Snakes in the British Museum (Natural History). Vol. 1, Typhlopidae, Glauconiidae, Boidae, Ilysiidae, Uropeltidae, Xenopeltidae, and Colubridae Aglyphae, part, 1893, pp. I-XII, 1-448, pls. 1-28, text figs. 1-26. Vol. 2. Colubridae Aglyphae, part, 1894, pp. I-XI, 1-382, pls. 1-20, text figs. 1-25. Vol. 3. Colubridae (Opisthoglyphae and Proteroglyphae), Amblycephalidae and Viperidae. 1896, pp. I-XIV, 1-727, pls. 1-25, text figs. 1-37.

———. 1897. Descriptions of new Malay frogs. Ann. Mag. Nat. Hist., ser. 6, vol. 19, pp. 106-108.

———. 1903a. Descriptions of three new Batrachians from Tonkin. Ann. Mag. Nat. Hist., ser. 7, vol. 12, pp. 186-188.

———. 1903b. On a new frog from Burma and Siam. Ann. Mag. Nat. Hist., ser. 7, vol. 12, p. 219.

———. 1903c. Pt. 1, Report on the batrachians and reptiles. *In* Annandale and Robinson, Fasciculi Malayenses, Anthropological and Zoological results of an expedition to Perak and the Siamese Malay States, 1901-1902, Zoology. pp. 131-170, pls. 5-10.

———. 1903d. List of the batrachians and reptiles recorded from Malay Peninsula, south of Tenasserim. *In* Annandale and Robinson, Fasciculi Malayenses; Anthropological and Zoological results of an expedition to Perak and Siamese Malay States, 1901-1902, pp. 171-176.

———. 1908a. A revision of the oriental pelobatid batrachians, genus *Megalophrys*. Proc. Zool. Soc. London, 1908, pp. 407-430, pls. 22-25.

———. 1908b. Report on the Gunong Tahan Expeditions, May to September, 1905. III. Report on the fishes, batrachians, and reptiles. Jour. Federated States Mus., vol. 3, pp. 61-72, pls. 4-5.

———. 1912. A Vertebrate Fauna of the Malay Peninsula from the Isthmus of Kra to Singapore, including the Adjacent Islands. Reptilia and Batrachia, pp. I-XIII, 1-286, figs. 1-7a.

———. 1913. A list of the reptiles obtained by Mr. H. Stevens in upper Assam and the eastern Himalayas. Rec. Indian Mus., Calcutta, 1913, pp. 337-338.

———. 1914. Description of new reptiles from Siam. Jour. Nat. Hist. Soc. Siam, vol. 1, pt. 1, pp. 67-70, pl. 1.

———. 1916a. Descriptions of new Reptiles from Siam. Jour. Nat. Hist. Soc. Siam, vol. 2, no. 2, pp. 90-102.

———. 1916b. Description of a new frog from Siam. Jour. Nat. Hist. Soc. Siam, vol. 2, pp. 103-105, 1 pl.

———. 1918a. Description of a new snake of the genus *Oligodon* from upper Burma. Proc. Zool. Soc. London, 1918, pp. 9-10, text figs.

———. 1918b. Description of a new lizard of the genus *Acanthosaura* from Yunnan. Ann. Mag. Nat. Hist., ser. 9, vol. 2, p. 162.

———. 1920. A monograph of the south Asian, Papuan, Melanesian, and Australian frogs of the genus Rana. Rec. Indian Mus., vol. 20, pp. 1-226.

BOURRET, RENÉ. 1934a. Les serpents marins de l'Indochine française. Édité par l'Institut Oceanographique de l'Indochine. 1934, pp. 1-69, pls. 1-10.

———. 1934b. Notes herpétoloqique sur l'Indochine française. Sur diverses collections de serpents appartenant a l'Université de Hanoi. Bull. Gén. l'Inst. Publ. Dec. 4, 1934, pp. 1-12, 1 pl. text-figs. 1-3.

———. 1934c. Notes herpétologiques sur l'Indochine française: III. Ophidians á Annam et du Moyen Laos. Bull. Gén. d'Inst. pub. No. 9, pp. 1-12, figs. 1-4.

———. 1934d. Notes herpétologique sur l'Indochine française. IV. Sur une collection d'Ophidiens de Cochinchine et du Cambodge. pp. 1-15. V. sur *Liopeltis major* et ses alliés. Bull. Gén. l'Inst. Publ., pp. 16-20, figs. 1-5.

———. 1935. Notes herpétologiques sur l'Indochine française. VIII. Sur les *Achalinus* d'Indochine. IX. Les serpents de Chapa. Bull. Gén. de l'Inst. Publ., No. 5 and No. 7, pp. 1-17, 5 figs.

———. 1936. Les Serpents de l'Indochine. Vol. I. Études sur la faune, 1936, pp. 1-141, text figs. 1-14. Vol. II. Catalogue systématique descriptive. Pp. 1-505, fig. 1-189. Toulouse, Henri Basuyan & Co.

———. 1937. Notes herpétologique sur l'Indochine française. XIV. Les batraciens de la collection de la Laboratoire des Sciences Naturelles de l'Universite. Descriptions de quinze espèces on varietés nouvelles. Ann. au Bull. Inst. Publ. No. 4, 1937, pp. 1-56, 15 figs. XV. Lézards et serpents recus au Laboratoire des Sciences Naturelles de l'Universite au cours de annee 1937. Bull. Gen. l'Inst. Publ. Dec. 4, 1937, pp. 57-80, figs. 1-7.

———. 1939a. Reptiles et batraciens recus au Laboratoire des Sciences Naturelles de l'Universite au cours de l'annee 1939. Descriptions de quatre espèces et d'une varieté nouvellles. Bull. Gén. l'Inst. Publ., Dec. 4, 1939, pp. 1-60, 1 color pl., 9 text figs.

———. 1939b. Notes herpétologique sur l'Indochine française XVII. Reptiles and batraciens recus au Laboratoire des Sciences Naturelles de l'Universite au cours de l'annee 1938. Descriptions de 3 espèces nouvelles. Annexe. Bull. Inst. Publ. No. 6, Feb., pp. 1-34, figs. 2, pl.

———. 1939c. Notes herpétologique sur l'Indochine française XIX. La faune herpétologique des stations d'altitude du Tonkin, Annexe. Bull. Inst. Publ. No. 4, December 1939, pp. 41-47.

———. 1939d. Notes herpétologique sur l'Indochine française XX. Liste des reptiles et batraciens actuellement connus en Indochine française. Annexe. Bull. Inst. Publ. No. 4, Dec., pp. 49-60.

———. 1941. Les tortues de l'Indochine. Inst. Oceanographique de l'Indochine, June 30, 1941, pp. 1-211. Color pls. A-F, pls. 1-48.

———. 1942. Les batraciens de l'Indochine. Inst. Oceanog. de Indochine, 1942 (?), pp. I-X, 1-547, text figs. 1-196, color pls. 1-4.

BOWRING. 1857. The Kingdom and People of Siam. London. 1857.

BRONGERSMA, L. D., 1930. Abnormal coloration of *Xenopeltis unicolor* Reinw. Copeia, 1930, no. 1, p. 87.

———. 1934. Contributions to Indo-Australian herpetology. Zool. Meded. Leiden, vol. 17, pp. 161-252.

BRONGNIART, A. 1800. Essai d'une classification naturelle des reptiles. Bull. Sci. Soc. Philom., Paris, vol. 2, pp. 89-91, 1 pl.

BURNE, R. H. 1905. Notes on the muscular and visceral anatomy of the leathery turtle *(Dermochelys coriacea)*. Proc. Zool. Soc. London, 1905, pp. 291-324, figs.

BUTLER, A. L., 1902. On recent additions to the Batrachian fauna of the Malay Peninsula. Proc. Zool. Soc. London, 1902, pp. 188-190.

———. 1903-04. A list of the batrachians known to inhabit the Malay Peninsula, with some remarks on their habits, distribution, etc. Jour. Bombay Nat. Hist. Soc., vol. 15, pp. 193-205, 387-402.

CANTOR, THEODORE E. 1847. Catalogue of reptiles inhabiting the Malay Peninsula and Islands, collected or observed by Theodore Cantor, Esq., M.D. Jour. Asiatic Soc. Bengal, vol. 16, pp. 607-656, 897-952, 1026-1078, pls. These were reprinted together, pp. 1-157 (1847?).

CARR, ARCHIE F. JR. 1942. Notes on sea turtles. Proc. New England Zool. Club, vol. 21, pp. 1-18, pls. 1-5.

———. 1952. Handbook of Turtles of the United States, Canada, and Baja California. Comstock, Ithaca, N.Y., pp. I-XV, 1-542, text figs. 1-36. (This book has an excellent bibliography of the turtles.)

CHABANAUD, P. 1923. Sur divers vértebrés à sang froid de la Region Indochinoise. I. Reptiles. Bull. Mus. Hist. Nat. Paris, vol. 29, p. 558.

COCHRAN, DORIS M. 1922. Description of a new species of agamid lizard from the Malay Peninsula. Proc. U.S. Nat. Mus., vol. 60, art. 26, pp. 1-3.

———. 1927. New reptiles and batrachians collected by Dr. Hugh M. Smith in Siam. Proc. Biol. Soc. Washington, vol. 40, pp. 179-192.

———. 1928. Natural history collecting by Dr. Hugh M. Smith in Siam. *From* Explorations and field-work of the Smithsonian Institution in 1927. Pp. 41-44, figs. 42-43.

———. 1930. The herpetological collections made by Dr. Hugh M. Smith in Siam from 1923 to 1929. Proc. U.S. Nat. Mus., vol. 77, art. 11, pp. 1-39, text figs. 1-6.

———. 1941. A new species of lizard from Siam. Copeia, 1941, no. 4, Nov. 21, pp. 238-239, text fig. 1.

COPE, EDWARD D. 1878. On the homologies of some of the cranial bones of the Reptilia and on the systematic arrangement of the class. Proc. Amer. Asso. Adv. Science, vol. 19, pp. 194-247.

CUVIER, G. I. C. F. D. 1807. Sur les différentes espèces de crocodiles vivans et sur leurs characteres distinctifs. Ann. Mus. Hist. Nat. Paris, vol. 10, pp. 8-66.

D'ABREAU, E. A. 1913. Effect of a bite from Schneider's water snake *(Hypsirhina enhydris)*. Jour. Bombay Nat. Hist. Soc., vol. 22, p. 203.

DAS, G. M., and B. K. DAS. 1932. On the binomics, life-history and anatomy of *Gecko verticillatus* Laurenti. Anat. Anz. Jena, Band 73, pp. 289-320, text figs.

DAUDIN, FRANÇOIS MARIE. 1802-03. Histoire naturelle, générale et particulière des reptiles, vol. 1-4, 1802, vols. 5-8, 1803. Paris.

DERANIYAGALA, P. E. P. 1930a. Testudinate evolution. Proc. Zool. Soc. London, 1930 (issued Jan., 1931), pp. 1057-1070, pls. 1-3.

———. 1930b. The Testudinata of Ceylon. Ceylon Jour. Sci. Sect. B, vol. 16, pp. 43-48, 7 pls.

———. 1939a. The Tetrapod Reptiles of Ceylon. Ceylon Jour. Sci. Colombo Museum Nat. Hist. Series, vol. 1, Testudinates and Crocodilians, pp. 1-XXXII, 1-412, pls. 1-24, text figs. 1-137.

———. 1939b. The crocodiles of Ceylon. Ceylon Jour. Sci. Sec. B, vol. 16, pt. 1, pp. 89-95, 2 pls.

———. 1960. The taxonomy of the cobras of southeastern Asia. Spolia Zeylanica, vol. 29, pp. 41-63, 4 pls., 1 fig.

DEUVE, J. 1961a. Observations sur les serpents du Laos avec description d'une variété nouvelle. Bull. Mus. Hist. Nat. Paris, ser. 2, vol. 32, pp. 376-379.

———. 1961b. Liste annotee des serpents du Laos. Bull. No. 1, Soc. Royal Sci. Nat. Laos (4th quarter), 1961, pp. 5-32.

———. 1962a. Notes herpetologiques. Bull. No. 2, Soc. Roy. Sci. Nat. Laos, No. 3, pp. 11-20, 6 figs.

———. 1962b. Les noms vernaculaires des serpents du Laos. Bull. No. 2, Soc. Roy. Sci. Nat. Laos (1st quarter), pp. 71-82, map of Laos.

———. 1962c. Clef d'identification des serpents du Laos. Bull. No. 4 (3rd quarter), Soc. Roy. Sci. Nat. Laos, no. 3, pp. 27-63, figs.

———. 1963a. *Natrix piscator* Schneider, Bull. Soc. Roy. Sci. Nat. Laos, No. 7, pp. 23-36, 4 figs. unnumbered.

———. 1963b. Observations sur la tendance à la division de certaines plaques chez *Natrix piscator piscator* Schneider. Bull. Soc. Roy. Sci. Nat. Laos, No. 7, pp. 37-44, text figs.

———. 1963c. Notes herpétologique. Bull. Soc. Roy. Sci. Nat. Laos, 1963, pp. 83-88, text figs.

DUMÉRIL, ANDRE MARIE CONSTANT, and G. BIBRON (and AUGUSTE DUMÉRIL for vols. 7-9). 1834-1854. Erpétologie Générale ou Histoire Naturelle Complete des Reptiles, vol. 1-9 & Atlas. Paris.

———. 1851. Catalogue Méthodique de la Collection des Reptiles. 2 vols. Paris, vol. 1, pp. I-IV, 1-128, vol. 2, pp. 129-224.

ESSEX, R. 1928. Studies in reptilian degeneration. Proc. Zool. Soc. London, 1927, 1928, pp. 879-945, text figs. & pls.

FISHER, W. 1939. A day at the snake farm in Bangkok. China Jour. Shanghai, vol. 31, 6, pp. 287-291, photos.

FITZINGER, LEOPOLDO. 1826. Neue Classification der Reptilien nach Ihren natürlichen Verwandschaften, nebst einer Verwandschafttafel und einem Verzeichnisse den Reptilian-Sammlung des K. K. Zoologischen Museum's zu Wien, 1826, pp. 1-66, 1 tabl.

———. 1835. Entwurf einer systematischen Anordnung der Schildkröten nach den Grundsätzen der natürlichen Methode. Ann. Wien Mus., vol. 1, pp. 105-128.

———. 1843. Systema Reptilium. Fasc. primus, Amblyglossae, pp. 1-106.

FLOWER, STANLEY SMYTH. 1896. Notes on a collection of reptiles and batrachians made in the Malay Peninsula in 1895-96, with a list of the species recorded from that region. Proc. Zool. Soc. London, Dec. 1, 1896, pp. 856-914, pls. 44-46 (in color).

———. 1898. On the identification of a *Gecko* from Penang. Proc. Zool. Soc. London, 1898, pp. 455-456.

———. 1899a. Notes on a second collection of reptiles made in the Malay Peninsula and Siam from November 1896 to September 1898, with a list of the species recorded from those countries. Proc. Zool. Soc. London, May 16, 1899, pp. 600-697, pls. 36-37.

———. 1899b. Notes on a second collection of batrachians made in the Malay Peninsula and Siam from November 1896 to September 1898, with a list of the species recorded from those countries. Proc. Zool. Soc. London, November 14, 1899, pp. 885-916, pls. 59-60 (in color).

FLYNN, A. A. L. 1932. The family of a Russell's Viper *Vipera russelli* or chain viper. Jour. Bombay Nat. Hist. Soc., vol. 36, p. 271.

FOX, E. BROOK. 1894. The Russell's Viper. Jour. Bombay Nat. Hist. Soc., vol. 8, p. 565.

FRY, DENE B. 1913. On the status of *Chelonia depressa* Garman. Rec. Australian Mus., vol. 10, pp. 159-185, text figs., 4 pls.

GADOW, HANS. 1901. Amphibia and reptiles. The Cambridge Natural History, vol. 8, pp. 1-668. Also a reprint edition in 1909, London.

GAIRDNER, K. G. 1914. Sluggishness of a python. Jour. Nat. Hist. Soc. Siam, vol. 1, no. 2, pp. 125-126.

———. 1915. Notes on the fauna and flora of Ratburi and Ratchaburi districts. Jour. Nat. Hist. Soc. Siam, vol. 1, no. 3, pp. 153-156.

GMELIN, JEAN FREDERIC. 1789. Systema naturae (of Linnaeus), 1789. Ed. 13.

GRAVENHORST, JEAN LOUIS CHARLES. 1829. Deliciae Musei Zoologici Vratislaviensis continuens Chelonias et Batrachia, fasc. 1, Lipsiae.

GRAY, J. E. 1830-1835. Illustrations of Indian Zoology, vols. 1 and 2, London.

———. 1831. Synopsis Reptilium, or short descriptions of the species of reptiles, Part I. Cataphracta, tortoises, crocodiles, enaliosaurians. London. Pp. 1-85, 10 pls.

———. 1834a. Characters of several new species of freshwater tortoises *(Emys)* from India and China. Proc. Zool. Soc. London, 1834, pp. 53-54.

———. 1834b. Characters of two new genera of reptiles *(Geoemyda* and *Gehyra)*. Proc. Zool. Soc. London, 1834, pp. 99-100.

———. 1844. Catalogue of Tortoises, Crocodiles and Amphisbaenians in the British Museum, pp. 1-80.

———. 1852. Description of a new genus and some new species of tortoises. Proc. Zool. Soc. London, 1852, pp. 133-135.

———. 1855. Catalogue of the Shield Reptiles in the Collection of the British Museum. Part I. Testudinata (Tortoises). London. 1855, pp. 1-82, pls. 1-42.

———. 1859. Description of a new species of freshwater tortoise from Siam. Proc. Zool. Soc. London, 1859, pp. 478-479, pl.

———. 1861a. Description of a soft tortoise from Camboja. Proc. Zool. Soc. London, 1861, pp. 41-42, pl.

———. 1861b. On some new species of Mammalia and tortoises from Camboja. Ann. Mag. Nat. Hist., ser. 3, vol. 6, pp. 217-218.

———. 1862a. Notice of a new species of *Cyclemys* from Lao Mountains in Siam. Ann. Mag. Nat. Hist., ser. 3, vol. 10, p. 157.

———. 1862b. Notes on two new species of *Batagur* in the collection of the British Museum. Proc. Zool. Soc. London, 1862, pp. 264-266.

———. 1862c. A synopsis of the species of crocodiles. Ann. Mag. Nat. Hist., ser. 3, vol. 10, pp. 265-274.

———. 1863. Observation on the box tortoises, with descriptions of three new Asiatic species. Proc. Zool. Soc. London, 1863, pp. 173-179.

———. 1864. Revision of the species of Trionychidae found in Asia and Africa with descriptions of some new species. Proc. Zool. Soc. London, 1864, pp. 76-98.

———. 1869a. Synopsis of the species of recent crocodilians or emydosaurians chiefly founded on specimens in the British Museum and the Royal College of Surgeons. Trans. Zool. Soc. London, 1869, pp. 125-160, 4 pls.

———. 1869b. Notes on the families and genera of tortoises (Testudinata) and on the characters afforded by the study of their skulls. Proc. Zool. Soc. London, 1869, pp. 165-225, text figs. 1-20, pl. XV.

———. 1870. Supplement to the Catalogue of Shield Reptiles in the Collection of the British Museum. Pt. 1, Testudinata (Tortoises), pp. I-X, 1-120, text figs. 1-40.

———. 1872a. Appendix to the Catalogue of Shield Reptiles in the Collection of the British Museum. Pt. 1. Testudinata (Tortoises). London. Pp. 1-28.

———. 1872b. Catalogue of Shield Reptiles in the Collection of the British Museum. Pt. 2. Emydosaurians, Rhynchocephalia and Amphisbaenians. London. Pp. 1-41, text figs. 1-24.

———. 1873. Hand-list of the Specimens of Shield Reptiles in the British Museum. London. Pp. 1-124.

GÜNTHER, ALBERT. 1859. Catalogue of the Batrachia Salientia in the Collection of the British Museum. London, 1858 (Feb. 12, 1859), pp. I-XVI, 1-160, pls. 1-12.

———. 1860. On the reptiles of Siam. Proc. Zool. Soc. London, 1860, pp. 113-117.

———. 1861. Second list of Siamese reptiles. Proc. Zool. Soc. London, Apr. 23, 1861, pp. 187-189.

———. 1864a. List of new species of reptiles discovered by the late M. Mouhot in Siam and Cambodia. *In* Mouhot, Travels in the Central Parts of Indo-China (Siam), Cambodia, and Laos, during the years 1858, 1859, 1860. (In 2 vols.) Vol. 2, Appendix, pp. 169-173.

———. 1864b. The Reptiles of British India. London. Pp. I-XXVII; 1-452, pls. 1-26.

———. 1868. First account of the species of tailless batrachians added to the collection of the British Museum. Proc. Zool. Soc. London, June 25, 1868, pp. 478-490, 4 pls.
———. 1882. Description of a new species of tortoise *(Geoemyda impressa)* from Siam. Proc. Zool. Soc. London, 1882, pp. 343-346, figs.
———. 1887. Notes on batrachians from Perak. Ann. Mag. Nat. Hist. ser. 5, vol. 20, pp. 312-316, pl. 16.
GYLDENSTOLPE, M. 1916. Zoological results of the Swedish Zoological Expedition to Siam. 1911-1912 and 1914-1915. I. Snakes. Kungl. Svensk. Vet-Akad. Handl., Band. 55, no. 3, pp. 1-28.
HARRISON, TOM. The edible turtle *Chelonia mydas* in Borneo. Sarawak Museum Jour. n.s. vol. 6, no. 4, pp. 126-128.
HASSELT, A. W. M. VAN. 1877. Contributions à l'histoire naturelle des salamandres aquatiques. Arci. Hierl (6) 12, pp. 215-297. A translation from the Dutch of the author's previous papers.
HAY, O. P. 1908. On three existing species of the sea-turtles, one of them *(Caretta remivaga)* new. Proc. U.S. Nat. Mus., vol. 34, p. 194.
———. 1928. Further considerations of the shell of Chelys and of the constitution of the armor of turtles in general. Proc. U.S. Nat. Mus., vol. 73, pp. 1-12, 2 pls.
HEIDIGER, HEINI. 1935. Studies of the Psychology and Behavior of Captive Animals in Zoos and Circuses. London. Pp. I-VII, 1-166, 16 pls.
HENDRICKSON, JOHN R. 1966. Observations on the fauna of Pulau Tioman and Pulau Talai. 5. The Reptiles. Bull. Natn. Mus. Str. Singapore No. 34, pp. 69-76.
HENDRICKSON, JOHN R., and E. BALESINGAME. 1966. Nesting beach preferences of Malayan sea turtles. Bull. Natn. Str. Singapore, no. 33, pp. 53-71.
HENNIG, WILLI. 1936. Revision der Gattung Draco (Agamidae). Temminckia, vol. 1, pp. 153-220, text figs. 1-11. Distributional maps, 1-14.
HOESEL, J. K. P. VAN. 1953. *Vipera russellii* its zoogeographical range and local distribution in Indonesia. De. Trop. Natuur. No. 4, pp. 133-139, fig.
HORA, S. L. 1922. Some observations on the oral apparatus of the tadpoles of *Megalophrys parva*. Jour. and Proc. Asiat. Soc. Bengal, vol. 18, pp. 9-15.
———. 1928. Further observations on the oral apparatus of the tadpoles of the genus *Megalophrys*. Rec. Ind. Mus., vol. 30, pt. I, pp. 139-145, pl. 3.
INGER, ROBERT F. 1966. The systematics and zoogeography of the Amphibia of Borneo. Fieldiana: Zoology, vol. 52, pp. 1-402.
INGER, ROBERT F., and HYMAN MARX. 1965. The systematics and evolution of the oriental colubrid snakes of the genus *Calamaria*. Fieldiana: Zoology, vol. 49, pp. 1-304, 73 figs.
IRVINE, F. R. 1960. Lizards and crocodiles as food for man. Brit. Journ. Herpet., vol. 2, pp. 197-202.
JAN, GEORGES, and FERDINAND SORDELLI. 1860-1881. Iconographie générale des ophidiens. Tome premier, livr. 1-17, Milan 1860-1866, pp. 1-11, 102 plates, numbered separately for each livrason. Tome seconde, livr. 18-34, 1866-1870, pp. 1-9, 102 pls. Tome troisieme, livr. 35-50, 1870-1881, pp. 1-20, 96 pls.
JOYNSON, H. M. 1924. Occurrence of the rat snake *(Zaocys carinatus)* in north Siam. Jour. Nat. Hist. Soc. Siam, Bangkok, vol. 6, no. 3, pp. 314-315.
KAMPEN, PIETER NICOLAAS VAN. 1923. The Amphibia of the Indo-Australian Archipelago. Leiden. pp. I-XII, 1-304.
KITCHENER, H. J. 1953. Skin change of the flying gecko *(Ptychozoon kuhli)* chechak kubin. Malay Nat. Jour., vol. 7, pp. 180-181, 2 pls.
KIRTISINGHE, P. 1946. The presence in Ceylon of a frog with direct transformation on land. Ceylon Jour. Sci., B., vol. 23, pp. 109-112.
KLEMMER, KONRAD. 1963. Liste der rezenten Giftschlangen Elapidae, Hydrophiidae, Viperidae and Crotalidae. Pp. 253-464. Bilden 1-37, in color.
KLOSS, C. B. 1907. Notes on the capture of a rare leathery turtle *(Dermochelys coriacea)* in Johore waters. Jour. Straits Settlements Brit. R. Asiat. Soc., pp. 63-65, 3 pls.
KOBAYASHI T., TAKAI, and I. HAYAMI. 1964. On some Mesozoic fossils from the Khorat series of east Thailand and a note on the Khorat series. *In* Kobayashi, Geology and Paleontology of Southeast Asia, vol. 1. Univ. Tokyo Press, Tokyo. Pp. 119-134, 1 pl.
LAURENTUS, JOSEPH NICOLAS. 1768. Specimen medicum, exhibens synopsis reptilium emendatum cum experimentis circa venena et antidota. Reptilium Austriacorum. Vienna.
LAIDLAW, F. F. 1900. On the frogs collected during the "Skeat Expedition" to the Malay Peninsula, 1899-1900. Proc. Zool. Soc. London, 1900, pp. 883-890, pl. 57.
———. 1901a. On a collection of lizards from the Malay Peninsula made by members of the Skeat Expedition, 1899-1900. Proc. Zool. Soc. London, 1901(1), pp. 301-311, fig.
———. 1901b. List of a collection of snakes, crocodiles and chelonians from the Malay Penin-

sula made by members of the "Skeat Expedition" 1899-1900, with an appendix containing a list of the names of places visited by the "Skeat Expedition" by W. W. Skeat. Proc. Zool. Soc. London, vol. 2, pp. 575-586, pl. 35.

LEKAGUL, BOONSONG. 1966. Tortoises of Thailand. Conservation News, Special issue No. 7, (actually issued Dec., 1965), pp. 56-59.

LESSON, R. P. 1834. [Description of birds, reptiles and zoophytes collected during Belanger's voyage to the East Indies.] *In* Belanger, Voyage aux Indes-Orientales. Zoologie.

LEVITON, ALAN, and WALTER C. BROWN. 1959. A review of the snakes of the genus *Pseudorabdion* with remarks on the status of the genera *Agrophis* and *Typhlogeophis* (Serpentes, Colubridae). Proc. California Acad. Sci., ser. 4, vol. 29, pp. 475-508, 10 figs.

LIDTH DE JEUDE, TH. W. VAN. 1891. List of the reptiles brought from Siam by M. R. C. Keun. Notes Leyden Mus., vol. 13 (note 41), pp. 255-256.

LINDHOLM, W. A. 1929. Revidiertes Verzeichnis der Gattungen der rezenten Schildkröten nebst Notizen zur Nomenklatur einiger Arten. Zool. Anz., Band 81, Heft 11/12, pp. 275-295.

LOCH, J. H. 1951. Notes on the Perak river turtle. Malayan Nature Jour., vol. 5, pp. 157-160, pls.

LÖNNBERG, EINAR. 1916. Zoological results of the Swedish Zoological Expeditional to Siam. 2. Lizards. Kungl. Svenska Vet.-Akad. Handl., Stockholm, vol. 55, no. 4, pp. 1-12, figs. 1-6.

LINNAEUS, C. 1758. Systema Naturae, 10th ed. 1758, vol. 1.

MCDOWELL, S. B. 1964. Partition of the genus *Clemmys* and related problems in the taxonomy of the aquatic Testudinidae. Proc. Zool. Soc. London, vol. 143, pt. 2, pp. 239-279, text figs. 1-11.

MELL, R. 1922. Beiträge zur Fauna Sinica. I. Die Vertebraten Sudchinas: Feldlisten und Feldnoten der Säuger, Vögel, Reptilien, Batrachien. Arch. Naturg., Berlin, Band 88A(10), pp. 103-146, 2 pls.

MERTENS, ROBERT. 1942. Zwei Bemerkungen über Schildkröten Südost-Asiens. Senckbergiana, Band 25, No. 1/3, pp. 41-46, figs. 1-4.

———. 1943a. Systematische und ökologische Bemerkungen über die Regenbogenschlange *Xenopeltis unicolor* Reinwardt. Der Zoologischegarten (N.F.), Band 15, Heft 5/6, pp. 213-220, 3 text figs.

———. 1943b. Die rezenten Krokodile des Natur. Museums Senckenberg. Senckenbergiana, Band 26, No. 4, Dec. 22, pp. 252-312, 12 pls., 32 figs.

———. 1950. Notes on some Indo-Australian monitors (Sauria, Varanidae). Amer. Mus. Novitates, 1950, No. 1456, pp. 1-7.

———. 1960a. Schwimmunfähige Wasserschildkröten. Natur und Volk, Band 90, Heft 4, pp. 127-133, text figs. 1-5.

———. 1960b. Zur Systematic und Nomenklatur der Ceylon-Krokodile. Senck. Biol., Band 41, No. 5/6, pp. 267-272.

MERTENS, ROBERT, and HEINZ WERMUTH. 1955. Die rezenten Schildkröten, Krokodile und Brückenechsen. Eine critische Liste der heute lebenden Arten und Rassen Zool. Jahrb. (Sept.), Band 83, Heft 5, pp. 323-440.

MICHIKURA, AKIRA. 1944. Poisonous snakes of Malaya. Contribution no. 3 from the Museum Selangor, Kuala Lumpur, 1944. 9 pls. (In Japanese.)

MOCQUARD, F. 1906. Les reptiles de l'Indo-Chine. La revue coloniale, July, 1906, pp. 1-59, (1907).

MOCQUARD, F., and GILBERT TIRANT. 1904. Recherches sur l'histoire naturelle de l'Indo-Chine française. (Reptiles), pp. 54-64. Lyon.

MOOK, CHARLES C. 1921a. Individual and age variations in the skulls of recent Crocodilia. Bull. Amer. Mus. Nat. Hist., vol. 44, pp. 52-66, pls. 10-12.

———. 1921b. Notes on the postcranial skeleton in the Crocodilia. Bull. Amer. Mus. Nat. Hist., vol. 44, pp. 67-101, pls. 13-14, text figs. 1-20.

———. 1921c. The dermo-supraoccipital bone in the Crocodilia. Bull. Amer. Mus. Nat. Hist., vol. 44, pp. 101-103, text figs. 1-2.

———. 1921d. Skull characters of recent Crocodilia, with notes on the recent genera. Bull. Amer. Mus. Nat. Hist., vol. 44, pp. 123-268.

MOOKERJEE, H. K. 1942. On the development of the vertebral column in Gymnophiona. Proc. 29th Indian Sci. Cong., vol. 159, pt. III, pp.

MORICE, ALBERT. 1875. Coupe d'oeil sur la faune de la Cochin-Chine française. Reptiles. Lyon. Pp. 54-64.

MOUHOT, M. HENRI. 1864. Travels in the Central Parts of Indo-China (Siam), Cambodia, and Laos During the Years 1858, 1859 and 1860. Two vols. with illustrations.

MOULTON, C. J. 1922. The reported occurrence of Russel's viper in Sumatra and the Malay Peninsula. Jour. Straits Asiatic Soc. Singapore, no. 85, pp. 206-207.
MÜLLER, F. 1892. Siebenter Nachtrag zum Katalog der Herpetologischen Sammlung des Basler Museums. Festschrift, 75 Verh. Ges. Basel, 1892, pp. 195-215, pl. 3.
MÜLLER, LORENZ. 1923. *Crocodilus siamensis* Schneider und *Crocodilus ossifragus* Dubois. Paleont. Hungarica, vol. 1, pp. 109-122, figs. 1-5.
———. 1924. Beiträge zur Osteologie der rezenten Krokodilien. Zeit. Morph. Oekol., Band 2, pp. 427-460, text figs., 2 pls.
MÜLLER, SAL. 1846. Ueber den Charakter der Thierwelt auf den Inseln des indischen Archipels, ein Beitrag zur zoologischen Geographie. Arch. für Naturgeschichte, 1846, Jahr. 12, Band 1, pp. 109-128.
MYERS, GEORGE S. 1953. Ability of amphibians to cross sea barriers with especial reference to Pacific Zoogeography. Proc. 7th Pacific Sci. Congress., vol. 4, pp. 19-27.
NIEDEN, FRITZ. 1923. Anura I. Das Tierreich, Lief. 46, pp. I-XXXII, 1-584, text figs. 1-380.
———. 1926. Amphibia, Anura II. Engystomatidae, Das Tierreich, Lief. 49, pp. I-XVI, pp. 1-111, text figs. 1-55.
NOBLE, GLADWYN KINGSLEY. 1926. An analysis of the remarkable cases of distribution among the Amphibia, with descriptions of new genera. Amer. Mus. Novitates. New York, no. 212, pp. 1-24, figs. 1-9.
———. 1931. The Biology of the Amphibia. Pp. I-XIII, 1-577, text figs. 1-174.
PARKER, H. W. 1928. The brevicipitid frogs of the genus *Microhyla*. Ann. Mag. Nat. Hist., ser. 10, vol. 2, pp. 473-499, figs. 1-4.
———. 1934. A Monograph of the Frogs of the Family Microhylidae. London. Pp. I-VIII, pp. 1-208, text figs. 1-67.
PENYAPOL, A. 1958a. A preliminary study of the sea turtles in the Gulf of Thailand (Siam). Nat. Hist. Bull. Siam Soc., vol. 17, pp. 23-36, 9 pls., 2 maps.
———. 1958b. A preliminary study of the sea turtles in the Gulf of Thailand (Siam). Proc. 9th Pacific Science Congress, vol. 16, p. 136.
PETERS, WILHELM CARL H. 1867. Herpetologische notizen. Monatsb. Akad. Wiss. Berlin. 1867, p. 29.
POULAIN, F. LE. 1941. Note sur les tortues de mer du golfe de Siam. Supplement *in* Bourret, Les tortues de l'Indochine. Pp. 215-218.
PURANANDA, CHALOEM. 1956. Treatment of snakebite cases in Bangkok. *In* Venoms, (Buckley, E. E. and N. Porges, eds.). Washington, D.C. Amer. Asso. Adv. Sci., pp. 353-358.
———. 1957. Poisonous snakes in Siam. Nat. Hist. Bull. Siam. Soc., vol. 18, pp. 1-14, 4 figs., 10 color pls., 2 maps.
RAI, K. 1936. Die Beeinflussung des Blutzuckers von Kaninchen durch die Gifte siamesischer Schlangenarten. Jour. Ned. Ass. Formosa, vol. 35, 10, pp. 2195-2209.
RAMASWAMI, L. S. 1958. The development of the apodan vertebral column. Zool. Anz., Band 16, Heft 11-12, pp. 271-279, text figs. 1-7.
ROBINSON, H. C. 1905. Further additions to the batrachian fauna of the Malay Peninsula with a list of the species at present known to occur therein. Jour. Federated Malay States Mus., vol. 1, pp. 19-24.
ROOIJ, NELLY DE. 1915-17. The Reptiles of the Indo-Australian Archipelago. Vol. 1. Lacertilia, Chelonia, Emydosauria. 1915. Pp. I-XIV, 1-384, text figs. 1-132; Vol. 2. Ophidia. 1917. Pp. I-XIV, 1-334 (Leiden).
ROUX, JEAN. 1906. Synopsis of the toads of the genus *Nectophryne* B and P, with special remarks on some known species and description of a new species from German East Africa. Proc. Zool. Soc. London, 1906, pp. 58-65, pl. 2.
RUST, H. 1934. Systematische Liste der lebenden Schildkröten. Blät. Aquar. Terrar., Band 45, pp. 42-45, 59-69.
SANDERS, A. 1872. Notes on the myology of *Liolepis belli*. Proc. Zool. Soc. London, 1872, pp. 154-183.
SCHAUENSEE, RODOLPHE MEYER DE. 1928. Random notes on Snakes in Siam. Bull. Antiven. Instit. Amer., Glenolden, Pa., vol. 2, no. 3, pp. 76-77.
SCHMIDT, KARL P. 1926. Amphibians and reptiles of the James Simpson-Roosevelt Asiatic Expedition. Publ. Field Mus. Nat. Hist., vol. 12, pp. 167-173.
———. 1927a. The reptiles of Hainan. Bull. Amer. Mus. Nat. Hist., vol. 54, pp. 395-465.
———. 1927b. Notes on Chinese reptiles. Bull. Amer. Mus. Nat. Hist., vol. 54, pp. 467-551.
———. 1928a. A new crocodile from New Guinea. Publ. Field Museum Nat. Hist., Chicago, vol. 12, pp. 177-181, pls.
———. 1928b. Notes on the herpetology of Indo-China. Copeia, 1928, no. 1, pp. 77-80.
SCHNEIDER, JOHAN. GOTTLOB. 1799-1801. Historiae amphibiorum naturalis et literarae. Fasc. I, 1799, pp. I-XIII, 1-264, pls. 1-2. Fasc. II, 1801, pp. I-VI, 1-374, pls. 1-2.

SIAH, Y. 1957. Siam crocodile. Nat. Hist. Bull. Siam. Soc., vol. 18, pp. 31-32, 4 pls.
SIEBENROCK, F. 1902. Zur Systematik der Schildkrötenfamilie Trionychidae Bell, nebst der Beschreibung einer neuen *Cyclanorbis* Art. Sitzb. Akad. Wiss. Wien, Band 111, Abt. 1, pp. 807-846, figs.
———. 1906. Zur Kenntnis der Schildkrötenfauna der Insel Hainan. Zool. Anz., Band 30, pp. 578-586.
———. 1909. Synopsis der rezenten Schildkröten mit Berücksichtigung der in historischer Zeit ausgestorben Arten. Zool. Jahrb., Jena (Suppl.), vol. 10, pp. 427-618.
SMEDLEY, NORMAN. 1931. Amphibians and reptiles from Cameron Highlands, Malay Peninsula. Bull. Raffles Mus., vol. 6, pp. 105-123.
———. 1932. Notes on the herpetological collections in the Selangor Museum. Bull. Raffles Mus., vol. 7, pp. 9-17.
SMITH, HOBART M., and L. F. JAMES. 1958. The taxonomic significance of cloacal bursae in turtles. Trans. Kans. Acad. Sci., vol. 61 (1), pp. 86-96.
SMITH, HOBART M., and EDWARD H. TAYLOR. 1950. An annotated checklist and key to the reptiles of Mexico exclusive of the snakes. Bull. U.S. Nat. Mus., no. 199, pp. I-V, 1-253.
SMITH, MALCOLM A. 1912. A list of the crocodiles, tortoises, turtles, and lizards at present known to inhabit Siam. Jour. Nat. Hist. Soc. Siam, vol. 21, pp. 48-57.
———. 1914a. The snakes of Bangkok. Jour. Nat. Hist. Soc. Siam, vol. 1, pp. 5-18, 3 pls.
———. 1914b. The distribution of *Ancistrodon rhodostoma* the Malayan viper in Siam. Jour. Nat. Hist. Soc. Siam, vol. 1, pp. 57-58.
———. 1914c. Large banded krait. Jour. Nat. Hist. Soc. Siam, vol. 1, no. 1, pp. 58-59.
———. 1914d. Occurrence of the krait *(Bungarus candidus)* and the small-spotted coral snake *(Callophis maculiceps)* in Siam. A new color variety of the latter. Jour. Nat. Hist. Soc. Siam, vol. 1, pp. 123-125.
———. 1914e. On the breeding habits of *Hypsirhina enhydris* and *Herpeton tentaculatum*, the tentacle snake. Jour. Nat. Hist. Soc. Siam, vol. 1, no. 1, pp. 126-127.
———. 1914f. Note on a rare lizard, *Lygosoma isodactylum*. Jour. Nat. Soc. Siam, vol. 1, no. 2, pp. 127-128.
———. 1914g. List of snakes at present known to inhabit Siam. Jour. Nat. Hist. Soc. Siam, vol. 1, no. 3, pp. 211-215.
———. 1915a. On reptiles and batrachians from the coast and islands of southeast Siam. Jour. Nat. Hist. Soc. Siam, vol. 1, no. 4, Dec. 1915, pp. 239-249.
———. 1915b. A new snake for Bangkok. Jour. Nat. Hist. Soc. Siam, vol. 1, no. 4, pp. 255-256.
———. 1915c. On the breeding habits and color changes in the lizard, *Calotes mystaccus*. Jour. Nat. Hist. Soc. Siam, vol. 1, no. 4, pp. 256-257.
———. 1915d. Notes on some snakes from Siam. Jour. Nat. Hist. Soc. Bombay, vol. 23, pp. 784-789.
———. 1916a. Descriptions of five tadpoles from Siam. Jour. Nat. Hist. Soc. Siam, vol. 2, no. 1, pp. 37-43, 2 pls.
———. 1916b. Descriptions of three new lizards and a new snake from Siam. Jour. Nat. Hist. Soc. Siam, vol. 2, no. 1, pp. 44-47, 1 pl.
———. 1916c. A list of the crocodiles, tortoises, turtles and lizards at present known to inhabit Siam. Jour. Nat. Hist. Soc. Siam, vol. 2, no. 1, pp. 48-57.
———. 1916d. On a collection of reptiles and batrachians from peninsular Siam. Jour. Nat. Hist. Soc. Siam, vol. 2, no. 2, pp. 148-171.
———. 1916e. On the frogs of the genus *Oxyglossus*. Jour. Nat. Hist. Soc. Siam, vol. 2, no. 2, pp. 172-175, pl. 1.
———. 1916f. Note on a rare sea snake *Thalassophis anomalus* from the coast of Siam. Jour. Nat. Hist. Soc. Siam, vol. 2, no. 2, pp. 176-177.
———. 1917a. Descriptions of new reptiles and a new batrachian from Siam. Jour. Nat. Hist. Soc. Siam, vol. 2, no. 3, pp. 221-225, 2 pls.
———. 1917b. A list of the batrachians at present known to inhabit Siam. Jour. Nat. Hist. Soc. Siam, vol. 2, no. 3, pp. 226-231.
———. 1917c. A two-headed snake. Jour. Nat. Hist. Soc. Siam, vol. 2, no. 3, pp. 255-256, 1 pl.
———. 1917d. A new frog for Bangkok. Jour. Nat. Hist. Soc. Siam, vol. 2, no. 3, pp. 256-257, 1 pl.
———. 1917e. On tadpoles from Siam. Jour. Nat. Hist. Soc. Siam, vol. 2, no. 4, pp. 261-275, 2 pls.
———. 1917f. Descriptions of a new snake and a new frog from Siam. Jour. Nat. Hist. Soc. Siam, vol. 2, no. 4, pp. 276-278.

———. 1917g. Preliminary diagnoses of four new sea snakes. Jour. Nat. Hist. Soc. Siam, vol. 2, no. 4, pp. 340-341.
———. 1918. Description of a new snake *Opisthotropis spenceri* from Siam. Jour. Nat. Hist. Siam, vol. 3, no. 1, p. 13, pl. 2.
———. 1919a. *Crocodilus siamensis*. Jour. Nat. Hist. Soc. Siam, vol. 3, no. 3, pp. 217-221, pls. 4-6.
———. 1919b. The lizards of the genus *Tropidophorus* in Siam with descriptions of two new species. Jour. Nat. Hist. Soc. Siam, vol. 3, no. 3, pp. 223-228.
———. 1919c. Remarks on Col. Wall's identification of *Hydrophis cyanocinctus*. Jour. Bombay Nat. Hist. Soc., vol. 26, no. 2, pp. 682-683.
———. 1920. On sea snakes from the coasts of the Malay Peninsula, Siam, and Cochin-China. Jour. Federated Malay States Mus., vol. 10, pp. 1-63, map, pl.
———. 1921a. Reptiles and batrachians collected on Pulo Condore. Jour. Nat. Hist. Soc. Siam, vol. 4, no. 2, pp. 93-97, 1 pl.
———. 1921b. A new name for the frog *Rana pullus*. Jour. Nat. Hist. Soc. Siam, vol. 4, no. 3, p. 193.
———. 1921c. Earth snake eating a grass snake. Jour. Nat. Hist. Soc. Siam, vol. 4, no. 3, pp. 196-197.
———. 1921d. New or little-known reptiles and batrachians from southern Annam (Indo-China). Proc. Zool. Soc. London, pp. 423-440, pls. 1-2, text figs. 1-2.
———. 1921e. Two new batrachians and a new snake from Borneo and the Malay Peninsula. Jour. Federated Malay States Mus., vol. 10, part 3, pp. 197-199, pl. 2.
———. 1922a. Notes on reptiles and batrachians from Siam and Indo-China (No. 1). Jour. Nat. Hist. Soc. Siam, vol. 4, no. 4, pp. 203-214, pl. 8.
———. 1922b. The frogs allied to *Rana doriae*. Jour. Nat. Hist. Soc. Siam, vol. 4, no. 4, pp. 215-225, pl. 9.
———. 1922c. The frogs allied to *Rana doriae*. Addendum. Jour. Nat. Hist. Soc. Siam, vol. 4, no. 4, pp. 227-229, text fig. 1.
———. 1922d. On a collection of reptiles and batrachians from the mountains of Pahang, Malay Peninsula. Jour. Federated Malay States Mus., vol. 10, pt. 4, pp. 263-282.
———. 1923a. Notes on reptiles and batrachians from Siam and Indo-China (No. 2). Jour. Nat. Hist. Soc. Siam, vol. 6, no. 1, pp. 47-53, pl. 5.
———. 1923b. A review of the lizards of the genus *Tropidophorus* on the Asiatic Mainland. Proc. Zool. Soc. London, Dec. 1923, pp. 775-781.
———. 1924a. New tree-frogs from Indo-China and the Malay Peninsula. Proc. Zool. Soc. London, Part 1, 1924, Mar. 31, pp. 225-234, pls. 1-3, 1 text fig.
———. 1924b. Descriptions of Indian and Indo-Chinese tadpoles. Rec. Indian Mus., vol. 26, pt. 2, pp. 137-144, pl. 7.
———. 1924c. Two new lizards and a new tree-frog from the Malay Peninsula. Jour. Federated Malay States Mus., vol. 2, pp. 183-186, 2 figs.
———. 1924d. The tadpole of *Tylototriton verrucosus* Anderson. Rec. Indian Mus. (Calcutta), vol. 26, pt. 2, pp. 309-310, pl.
———. 1925. A new ground gekko *Gymnodactylus* from the Malay Peninsula. Bull. Raffles Mus., no. 7, Jour. Mal. Asiat. Soc. Singapore, vol. 3, pt. 1, p. 87.
———. 1926a. The function of the "funnel" mouth of the tadpoles of *Megalophrys,* with a note on *M. aceras* Boulenger. Proc. Zool. Soc. London, 1926, pp. 983-988, 2 figs.
———. 1926b. Monograph of sea-snakes Hydrophiidae. British Museum, 1926, pp. I-XVII, 1-130, pls. 1-2, text figs. 1-35.
———. 1927. Contributions to the herpetology of the Indo-Australian Region. Proc. Zool. Soc. London, 1927, pp. 199-225, pls. 1-2, text figs. 1-4.
———. 1928. Two vipers new to Siam. Jour. Nat. Hist. Soc. Siam, vol. 7, no. 3, p. 194.
———. 1930. The reptilia and amphibia of the Malay Peninsula from the Isthmus of Kra to Singapore, including the adjacent islands. (A supplement to G. A. Boulenger's Reptilia and Batrachia 1912.) Bull. Raffles Mus., no. 3, pp. 1-149, text figs. 1-13.
———. 1931a. The Fauna of British India, including Ceylon and Burma. Reptilia and Amphibia, vol. 1, Loricata and Testudines. London. Pp. 1-185, pls. 1, 2, and 42 text figs.
———. 1931b. The herpetology of Mount Kinabalu North Borneo, 13,455 ft. Bull. Raffles Mus., no. 5, pp. 3-32, figs., pls.
———. 1932. Some notes on the monitors. Jour. Bombay Nat. Hist. Soc., vol. 35, p. 479.
———. 1933. Remarks on old world gekkoes. Rec. Indian Mus., pp. 9-19, text figs.
———. 1935a. The sea snakes *Hydrophiidae*. The Carlsberg Foundation's Oceanographical Expedition Round the World, 1929-1930 and previous "Dana"-Expeditions. Dana-Report no. 8 (July 10), pp. 1-6.

———. 1935b. On a collection of reptiles and Amphibians from Perak, Malay Peninsula. Bull. Raffles Mus., Singapore Straits Settlements, No. 10, pp. 61-63, pl. 4.
———. 1935c. The Fauna of British India, including Ceylon and Burma. Reptilia and Amphibia, vol. 2. Sauria. London. Pp. I-XIII, 1-440, pl. 1, 2 maps, text figs. 1-94.
———. 1937a. A Bangkok python. Jour. Siam. Soc. Nat. Hist. Suppl., vol. 11, pp. 61-62.
———. 1937b. Breeding habits of the Indian Cobra. Jour. Siam. Soc. Nat. Hist. Suppl., vol. 11, pp. 62-63.
———. 1937c. *Draco blanfordi* and its allies. Bull. Raffles Mus., Singapore, Straits Settlements, No. 13, pp. 71-75, pl. 8.
———. 1937d. A review of the genus *Lygosoma* (Sincidae:Reptilia) and its allies. Rec. Ind. Mus., Calcutta, vol. 39, pt. 3, pp. 213-234, text figs. 1-5.
———. 1937e. Un nouveau lèzard de Cochinchine. Bull. Mus. Nat. d'Hist. Nat., ser. 2, vol. 9, no. 6, p. 366.
———. 1938. The nucho-dorsal glands of Snakes. Proc. Zool. Soc. London, Series B, vol. 108, pt. 3, pp. 575-583, pl. 1, text figs. 1-5.
———. 1939. A revision of the Acrochordinae *(snakes)*. Ann. Mag. Nat. Hist., ser. 11, vol. 3, pp. 393-395.
———. 1940. A new snake of the genus *Anomochilus* from the Malay Peninsula. Ann. Mag. Nat. Hist., ser. 11, vol. 6, pp. 447-449, text fig.
———. 1943. The Fauna of British India, Ceylon and Burma, Including the whole of the Indo-Chinese Subregion. Reptilia and Amphibia. Vol. III, Serpentes, pp. I-XII, 1-583, 1 map, 166 text figs.
SMITH, M. A., and E. HINDLE. 1931. Experiments with the venom of *Laticauda, Pseudechis* and *Trimeresurus* species. Jour. Roy. Soc. Trop. Med. Hygiene, vol. 25, pt. 2, pp. 115-117.
SMITH, M. A., and BODEN K. KLOSS. 1915. On reptiles and batrachians from the coast and islands of south-east Siam. Jour. Nat. Hist. Siam, vol. 1, no. 3, pp. 237-249.
SODERBERG, PAUL. 1966. The seven major poisonous snakes of Thailand. Conservation News, Special issue no. 7 (issued Dec., 1965), pp. 60-64.
———. 1966a. Two little known snakes from Khao Yai. Nat. Hist. Bull. Siam Soc., vol. 21, pp. 35-43, pl.
———. 1966b. Confirmation of two colour phases of the tentacled snake, *Erpeton tentaculatum*. Nat. Hist. Bull. Siam Soc., vol. 21, p. 342.
———. 1966c. The proper scientific name of the hamadryad or king cobra. Nat. Hist. Bull. Siam Soc., vol. 21, p. 343.
SOWERBY, J. DE, and E. LEAR. 1872. Tortoises, Terrapins and Turtles. London. 60 pp., plates in color.
STOLICZKA, FERDINAND. 1870. Observations on some Indian and Malayan Amphibia and Reptilia. Jour. Asiat. Soc. Bengal, vol. 39, pp. 134-157, 159-228, pls. 9-12.
———. 1873. Notes on some species of Malayan Amphibia and Reptilia. Jour. Asiat. Soc. Bengal., vol. 42 (2), pp. 11-26, pl. 11. Reprinted in Misc. Papers relating to Indo China, vol. 1, 1887, pp. 72-87.
SUVATTI, C. 1938. A Check-List of Aquatic Fauna in Siam. (Amphibia, Testudines, Crocodilia.) Bangkok, pp. 81-97.
———. 1950. Fauna of Thailand, Bangkok (Dept. of Fisheries). Pp. I-II, 1-1100, frontisp.
SWORDER, G. HOPE. 1925. Notes on *Lygosoma bouringi* and *L. atrocostatum*. Singapore Naturalist, No. 5, 1925, p. 101.
TAYLOR, E. H. 1920. Philippine Turtles. Philippine Jour. Sci., vol. 15, pp. 1-144, pls. 1-7.
———. 1934. Zoological results of the Third de Schanensee Siamese Expedition, pt. III. Amphibians and reptiles. Proc. Acad. Nat. Sci. Philadelphia, vol. 86, pp. 281-310, pl. 17, text figs. 1-4.
———. 1960. On the Caecilian species *Ichthyophis glutinosus* and *Ichthyophis monochrous* with descriptions of related species. Univ. Kansas Sci. Bull., vol. 40, no. 8, pp. 37-120, figs. 1-38.
———. 1962a. New oriental reptiles. Univ. Kansas Sci. Bull., vol. 43, no. 7, pp. 209-263, figs. 1-18.
———. 1962b. The amphibian fauna of Thailand. Univ. Kansas Sci. Bull., vol. 43, no. 8, pp. 265-599, figs. 1-107.
———. 1963a. New and rare oriental serpents. Copeia, 1963, no. 2, June 12, pp. 429-433.
———. 1963b. The lizards of Thailand. Univ. Kansas Sci. Bull., vol. 44, no. 14, pp. 687-1077, figs. 1-99, 1 map.
———. 1965a. The serpents of Thailand and adjacent waters. Univ. Kansas Sci. Bull., vol. 45, no. 9, pp. 609-1096, figs. 1-125.

———.1965b. New Asiatic and African caecilians with redescriptions of certain other species. Univ. Kansas Sci. Bull., vol. 46, no. 6, pp. 253-302, figs. 1-28.

———. 1968. Caecilians of the World. A Taxonomic Review. Univ. Kansas Press, pp. I-XIV, 1-848, figs. 1-425.

TAYLOR, E. H., and ROBERT E. ELBEL. 1958. Contribution to the herpetology of Thailand. Univ. Kansas Sci. Bull., vol. 38, pt. II, pp. 1033-1189, figs. 1-36.

TENNENT, SIR J. EMERSON. 1861. Sketches of the Natural History of Ceylon with Narratives and Anecdotes Illustrative of the Habits and Instincts of Mammalia, Birds, Reptiles, Fishes, and Insects, etc. Including a Monograph on the Elephant and a Description of the Modes of Capturing and Training it. London. Pp. I-XXIII, 1-500, 79 pls. and figs.

THEOBALD, WILLIAM. 1868. Catalogue of the reptiles of British Burma, embracing the provinces of Pegu, Martaban and Tenasserim, with descriptions of new or little-known species. Jour. Linn. Soc. Zool., vol. 10, no. 41, Zoology, pp. I-X, 4-67.

———. 1880. *In* Mason, Burma its People and Productions. I. Herpetology, pp. 288-344 and appendix pp. 497-501.

THUNBERG, C. P. 1787. *In* Kongliga Svenska Vetenskaps-Academien Handlingar, viii (not seen).

TICKELL, S. R. 1862. A rare and little-described species of turtle. Jour. Asia Soc. Bengal, vol. 31, pp. 367-370, 1 colored pl.

TIRANT, GILBERT. 1885a. Notes sur les Reptiles et les Batraciens de la Cochinchine et du Cambodge (Saigon, Imprimerie du gouvernment), pp. 1-104.

———. 1885b. Notes sur les reptiles et les batraciens de la Cochinchine et du Cambodge. Exc. et Recon, 21 (Batraciens), pp. 236-446.

TWEEDIE, M. W. F. 1952. The paradise tree snake. Malay Nat. Jour., vol. 7 (2), 1952, p. 67, 1 pl.

———. 1953a. The breeding of the leathery turtle. Proc. Zool. Soc. London, vol. 123, 1953, pp. 273-275, 3 pls.

———. 1953b. The Snakes of Malaya. Singapore, Govt. Printing. Pp. 1-139, 27 figs.

TWEEDIE, M. W. F., and J. L. HARRISSON. 1954. Malayan Animal Life. Longman, Green & Co., London. Pp. I-X, 1-237, 154 figs.

UNDERWOOD, GARTH. 1967. A contribution to the Classification of Snakes. British Museum. London, pp. 1-179.

WAGLER, JEAN. 1830. Naturliches System der Amphibien mit vorangehender Classification der Säugethiere und Vögel. Münich.

WANADORN, LUANG WINIT. 1918. The Siamese names of some snakes. Jour. Nat. Hist. Soc. Siam, vol. 3, pp. 46-47.

WANDOLLECK, B. 1900. Zur Kenntniss der Gattung *Draco* L. Abh. Ber. Zool. Mus. Dresden, vol. 9, no. 3, pp. 1-16, pl.

WERMUTH, H. 1953. Systematik der rezenten Krokodile. Mitt. Zool. Mus. Humboldt-Univ. Berlin, pp. 375-514, figs. 1-66.

———. 1954. Zur Nomenclatur und Typologie des leistenkrokodils, *Crocodylus porosus* Schneider 1801. Mitt. Zool. Mus. Humboldt-Univ. Berlin. Band 30, Heft 2, pp. 483-486, pl. 63.

———. 1958. Die groskopfschildkröten *Platysternon megacephalum* Gray. Aquar. und Terrar. Leipzig. Band 5, Heft 6, pp. 161-165, 6 figs. unnumbered.

———. 1960. Systematischer Status der grosskopfschildkröte *Platysternon megacephalum* Gray, 1831. Zool. Beitrage, N. F. Band 5, pp. 471-482, 7 figs.

WERNER, FRANZ. 1926. Neue oder wenig bekannte Schlangen aus dem Wiener naturhistorischen Staatsmuseum (III Teil). Sitz-Ber. Akad. Wiss. Wien, Abt. 1, vol. 135, pp. 243-257.

———. 1933a. Über *Champse brevirostris* ein neues Krokodil aus Africa nebst einigen Bemerkungen über Systematik der Loricaten. Zool. Anz., Band 102, Heft 3/4, pp. 100-107.

———. 1933b. Loricata, Das Thierreich. Lief. 62, pp. 1-40.

WILLIAMS, E. E. 1952. A new fossil tortoise from Mona Island, West Indies and a tentative arrangement of the tortoises of the world. Bull. Amer. Mus. Nat. Hist., vol. 99 (2), pp. 541-560.

WILLIAMS, E. E., ALICE G. C. GRANDISON and ARCHIE F. CARR, JR. 1967. *Chelonia depressa* Garman re-investigated. Breviora, Mus. Comp. Zool., Cambridge (no. 271), pp. 1-15, pls. 1, 2, text figs. 1, 2.

WILLISTON, SAMUEL W. 1925. The Osteology of the Reptiles. Harvard Press. Pp. I-XIII, pp. 1-298, figs. 1-191.

WOLF, S. 1936. Revision der Untergattug *Rhacophorus* (ausschliesslich der Madagascar-Formen). Bull. Raffles Mus., no. 12, pp. 137-217, figs. 1-8.